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OPERATION AND MAINTENANCE MANUAL

for

MODEL 4100/4150 PARTICLE COUNTER

HIAC/ROYCO

OCT 14 1986
MICROMEDIA

All Hiac/Royco products are warranted against defects in materials and workmanship. This warranty applies for one year from date of delivery, or in the case of certain major components listed in the operating manual, for specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hiac/Royco. No other warranty is expressed or implied. Hiac/Royco is not liable for consequential damages. Your authorized Hiac/Royco Field Engineer is ready to assist you and you are welcome to contact directly the Hiac/Royco Service Department:

CUSTOMER SERVICE
HIAC/ROYCO INSTRUMENTS
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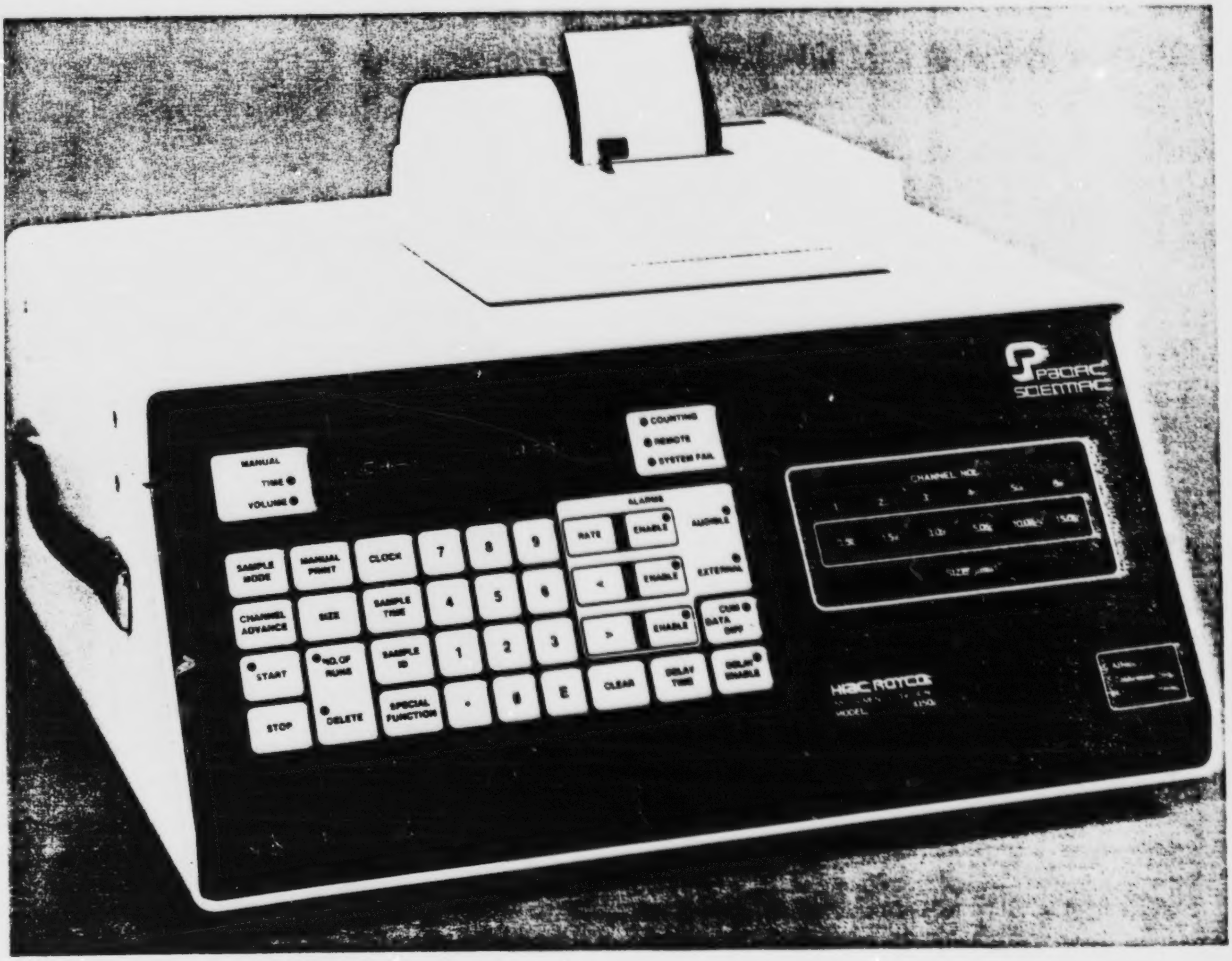
415/325-7811

77 pp

MODEL 4150

The Model 4150 is identical to the Model 4100 except that the Channel Thresholds in the 4150 are preset at the factory.

Any reference in this manual to setting the Thumbwheel Switches or the Channel Thresholds should be ignored by the 4150 operator. The 4150 Channel Thresholds should not be reset.



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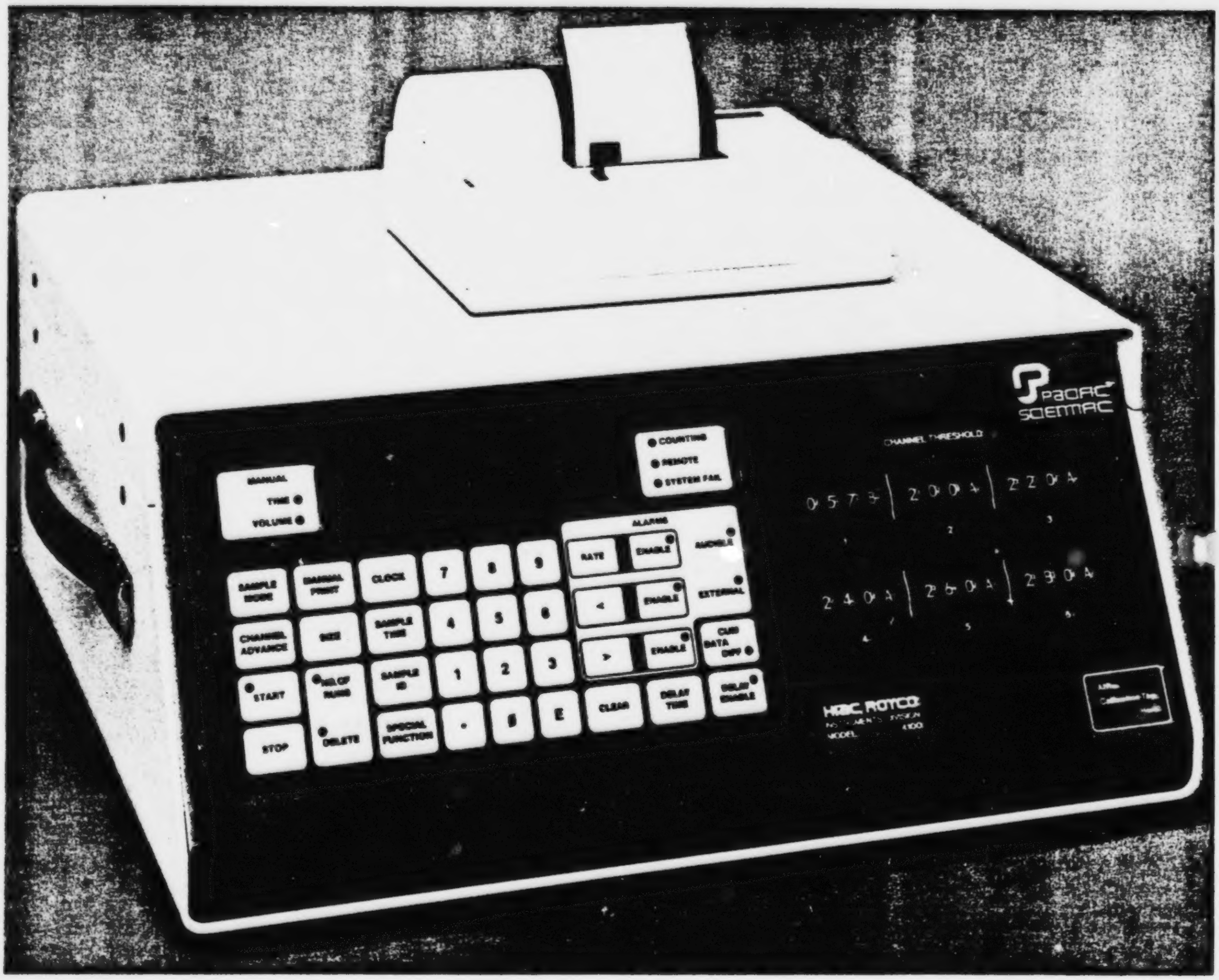


Figure 1-1. Model 4100 Particle Counter

CHAPTER 1

GENERAL DESCRIPTION

1.1 GENERAL INFORMATION

The HIAC/ROYCO Model 4100 is a microprocessor based particle counter which provides high-speed precise particle size information on a wide variety of materials suspended in liquid or air.

It is able to acquire count data in six particle size ranges which can be independently set by the thumbwheel switches on the front panel. When the instrument is in the cumulative mode, each channel counts all particles larger than the threshold. In the differential mode each channel counts particles between the two adjacent thresholds.

Count data are presented on the 20 character alphanumeric LED display and transmitted out serially by the standard RS232C format.

Keyboard parameter settings are retained even with the removal of ac supply, and a battery-backed clock/calendar allows sample and event data to be chronicled.

The Model 4100 provides many self-check features to insure that the entire particle counting system is operating correctly at power-up. Periodic checks are automatically performed to insure that the entire system is operating correctly and that no failures have occurred, unnoticed, that would affect the count data. The alarm system includes audible alarm as well as user-accessible relay control.

1.2 PHYSICAL and PERFORMANCE SPECIFICATIONS

Table 1-1. PHYSICAL AND PERFORMANCE SPECIFICATIONS

WEIGHT	26 lbs.
DIMENSIONS	16½ in. wide X 7½ in. high X 15 in. deep
POWER REQUIREMENTS	
Voltage	100/120/200/240 VAC ±10%, 50/60 Hz
Fuse	3 amp SB at 100/120 VAC 1.5 amp SB at 220/240 VAC
ENVIRONMENT	
Temperature	32° to 104° F
Humidity	to 98% relative, non-condensing

(Table continued on next page)

Table 1-1. SPECIFICATIONS (continued)

PARTICLE DATA ANALYZER	
Number of Channels	Six, independently controlled, user selectable size channels
Sampling Modes	
Manual	Manual START/STOP for sampling
Time	Sampling under control of sample timer
Volume	Sampling under control of external volume sampler
Sample Time	1 second to 99 minutes and 99 seconds
Delay Time	Zero to 99 hours and 99 minutes
Count Mode	
Cumulative	Counts total particles equal to or greater than selected size
Differential	Counts particles equal to or greater than selected size, but less than the next selected size
Count Capability	Maximum of 7 digits in each size range
DATA PRESENTATION	
Display	20 character alphanumeric display
Serial Output Data	Standard RS232C format. Baud Rate selectable: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600. Word length: 8 bits with 1 stop bit and no parity.
Printer	Optional external 20-column alphanumeric serial thermal printer prints count data and other system information
ALARM CONTROL	
Rate	Number of particles per minute from 60 to 999,999
>	Particle counts greater than a given number during an entire sample run - 7 digits maximum
<	Particle counts less than a given number during en entire sample run - 7 digits maximum
Alarm Controls	Individual alarm type enable or disable indicated by LEDs
Alarm Channel	All 3 alarms set on a single user-specified channel (1 through 6) default to Channel 1 if none specified.
Alarm Indication	(1) Flashing LED (2) Activation of a 240V/3A rated relay for external alarm (3) Audible beep (R12 on Input/Output board controls volume) (4) Alarm data printed at the end of sample run.

Table 1-1. SPECIFICATIONS (continued)

SPECIAL FEATURES	
Multiple Run	Up to 10 sample runs are selectable from the keyboard. Data for each run is printed at the end of that run and will be averaged unless manually deleted during 15-second delete time. Run average is printed at the end of selected number of runs.
Clock/Calendar	Clock/Calendar reading month/day/year - hour/minute/second is battery backed to keep time when unit is off or disconnected from ac power supply.
Self Diagnosis	(1) EPROM checksum (2) RAM test (3) Battery RAM test (4) Battery test (5) Clock test (6) Keyboard LED test (7) Beeper test (8) Display LED test (9) Base Line test (10) Overconcentration test
Battery-Backed RAM	RAM is battery-backed to retain parameters when power is removed. Battery is charging when power is on.
Special Functions	Ten special functions can be specified from the keyboard: 00 displays and prints SYSTEM FAIL 01 prints SYSTEM STATUS 02 specifies ALARM CHANNEL 03 specifies STABILIZATION DELAY time 04 displays ELAPSED TIME during sample counting time 05 specifies SAMPLE VOLUME 06 displays two channels simultaneously 07 calibrates air sensor 08 allows printer to print only sample runs with an ALARM condition 09 allows SHORT PRINT format 10 allows printout in computer format

INTERFACE CONNECTIONS	
Sensor	Air/liquid compatible
Sampler	Volumetric or non-volumetric
Serial	RS232C serial output
Scanner	Model 160/161 multi-valve
Remote Control	External start/stop control signal
External Alarm	User relay triggered by the alarm control setting
Power Plug	International listed three-prong receptacle

2.1 WARRANTY POLICY, continued.....

c. (cont.....)
Any item required to be returned by purchaser to a HIAC/ ROYCO service center must be shipped prepaid. If upon receipt the item is determined to be defective by HIAC/ ROYCO, the repaired or replacement item will be returned to the purchaser shipping charged prepaid (U.S.A. and Europe only). If the item is found by HIAC/ROYCO not to be defective, the item will be returned by HIAC/ROYCO freight collect.

d. Purchaser may elect to have warranty repair or replacement performed in its plant, if possible, in which case purchaser shall pay all transportation and expenses for HIAC/ROYCO personnel and equipment.

e. This warranty shall not apply to or include any of the following:

Repair or replacement required as a result of (i) accident, (ii) misuse or neglect, (iii) lack of reasonable and proper maintenance, (iv) repairs improperly performed or replacements improperly installed, (v) use of replacement parts or accessories not conforming to HIAC/ROYCO's specifications which adversely affect performance and/or durability, (vi) alterations or modifications not recommended or approved in writing by HIAC/ ROYCO, and/or (vii) wear and deterioration occasioned by the use of the equipment.

Liability of HIAC/ROYCO under this warranty is limited solely to the remedying of defects in material and workmanship at a HIAC/ROYCO authorized repair facility during customary business hours. This warranty does not cover inconvenience of loss of use of the equipment. HIAC/ROYCO shall not be liable for any other expense, loss, or damage, whether direct, incidental, consequential, or exemplary arising in connection with the sale or use of or inability to use the equipment for any purpose.

HIAC/ROYCO makes no other warranty of any kind, expressed or implied. ALL IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH EXCEED THE OBLIGATIONS AND TIME LIMIT STATED IN THIS WARRANTY ARE HEREBY DISCLAIMED BY HIAC/ROYCO AND EXCLUDED FROM THIS WARRANTY.

The foregoing statements of warranty are exclusive and in lieu of all other remedies.

Representations and warranties made by any person, including representatives of HIAC/ROYCO, which are inconsistent or in conflict with the terms of this warranty shall not be biding upon HIAC/ROYCO unless in writing and signed by an officer of HIAC/ROYCO.

CHAPTER 2

WARRANTY AND SERVICE

2.1 WARRANTY POLICY

HIAC/ROYCO Instruments Division, Pacific Scientific warrants to the original purchaser in the country of delivery that all equipment sold by an authorized representative, shall be free, under normal use and maintenance, from any defect in material and workmanship for a period of one year from date of delivery, subject to the following conditions, exclusions, obligations, and limitations.

a. The following purchased products are specifically excluded from the terms of this warranty:

   1. Stand-alone products not manufactured by HIAC/ROYCO and not possessing a HIAC/ROYCO logo. Such products are covered by the original manufacturer. In the event of failure, HIAC/ROYCO will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

b. Any material or workmanship found to be defective by HIAC/ROYCO within the one year term shall be remedied without charge for parts or labor.

c. When an instrument, component, or accessory is claimed to be defective, HIAC/ROYCO shall determine whether or not the item shall be returned by purchaser to HIAC/ ROYCO Service Center:

HIAC/ROYCO Service Center, 2224 Rt. 130 South, Box 19, Park Plaza Mall
Beverly, NJ 08010 Tel: 609/871-2220

HIAC/ROYCO Midwest Service Center 651-3 South 8th
West Dundee, IL 60118 Tel: 312/428-7794

HIAC/ROYCO Instruments, Inc., 141 Jefferson Drive
Menlo Park, CA 94025 TLX: WU 348323 (ROYCOINSTR MNPK)
RCA 278944 (HRID UR) Tel: 415/325-7811

PACIFIC SCIENTIFIC GmbH, Froebelstrasse 7 TLX: 841 7245709 (ROYO D)
D-7250 Loenberg, West Germany (Postfach 1644) Tel: 7152-42075,
7152-42076

PACIFIC SCIENTIFIC SARL, 2 bis rue Leon Blum TLX: 842 691705 (PSHRF)
91120 Palaiseau, France Tel: (6) 011-96-11

2.2 PREPARATION FOR USE

The Model 4100 may be located adjacent to any other laboratory equipment, provided the temperature and humidity are within the limits specified in Table 1-1. The only requirement is that a free flow of air be allowed around the equipment and that ventilation not be obstructed.

2.2.1 General Precautions

Certain precautions must be taken to avoid injury to the operator or damage to the equipment.

a. Do not remove circuit boards while power is on. In the case of power supply circuit boards, allow 3 to 5 seconds for the power supply capacitors to discharge after turning off the power.

b. Use extreme care to avoid bodily contact with the electrical components.

c. Although connections may be made to the monitoring connectors on the rear panel of the 4100 at any time during operation, connect only high impedance equipment.

d. Whenever moving or carrying the Model 4100, use both handles.

2.2.2 Rear Panel Connections

All power and interface connectors are on the rear panel of the unit as shown in Figure 2-1. Table 2-1 lists the rear panel controls and connectors with reference designation and function.

2.2.3 Baud Rate Selection

The Baud rate is selectable with S1 on top of the Input/Output board. (See Figure 5-1.) It is preset to 9600 at the factory unless otherwise specified.

S1 SELECTION CHART X = ON

BAUD RATE / S1	50	75	110	134.5	150	200	300	600	1200	1800	2400	2400	4800	9600
1	X			X	X			X		X		X		X
2				X		X	X					X	X	X
3	X	X							X	X			X	X
4	X	X		X		X		X			X			

2.1.1 Non-Warranty Service

An inventory of critical replacement parts or sub-assemblies is maintained for all instruments for 5 years from the last sale of that instrument.

Service, either at the factory or from the field, will be billed to the nearest quarter hour at current rates for standard and overtime labor. Travel expenses for HIAC/ROYCO personnel to the customer's facility will be based on actual cost.

2.1.2 Service Contracts

Routine preventive maintenance and calibration will extend the useful life of your instrument. In addition to our standard warranty, Hiac/Royco Service and Calibration programs provide for the services of a factory-trained and supervised field engineer at scheduled intervals to perform preventive maintenance and prime calibration at your facility. For information on this program contact Hiac/Royco Customer Service.

2.1.3 Transit Damage Claims

All instruments are insured for safe delivery. Your instrument should be inspected and tested as soon as it is received. If it is damaged in any way, or fails to operate properly, file a claim with the carrier, or if insured separately, with the insurance company. (As in any repair situation, the instrument remains the property of the customer.) Freight claims for loss or damage while in transit between the customer and Hiac/Royco must be handled by the customer.

2.1.4 Repackaging for Shipment

The original shipping carton and packaging materials should be used for shipment. If they are not available, or reusable, the instrument should be repackaged with the following materials:

(1) A double-walled carton.

(2) Heavy paper, or sheets of cardboard to protect all instrument surfaces.

(3) At least 4 inches of shock absorbing material such as extra firm polyurethane foam.

(4) Heavy-duty shipping tape to secure outside of carton.

Table 2-1. REAR PANEL CONTROLS AND CONNECTORS

PANEL NOMENCLATURE	REFERENCE DESIGNATION	FUNCTION
POWER OFF/ON	S101	Rocker switch that controls power application
RESET	S102	Momentary pushbutton switch used to reset Model 4100
FUSE	F101	Slow-blow fuse to provide overload protection 3 amp SB at 100/120 VAC or 1.5 amp SB at 220/240 VAC
EXTERNAL ALARM	TB101	Connector for an external alarm - Maximum limit of the internal relay is 240 volts ac or dc at 3 amps.
REMOTE CONTROL	TB102	Connector for external start and stop control
POWER	J101	Connector for three-wire power cord
SERIAL I/O	J102	Connector to provide serial communication with external device using RS232C format
SCANNER	J103	Connector to Model 160/161 Scanner (Cable #930-0020)
SIGNAL OUT	J104	Provides buffered input signal to external equipment.
SIGNAL IN	J105	Signal input connector (10 volt maximum amplitude)
(Spare)	J106	Spare connector for future options
LAMP VOLTAGE	J107	Test jacks for voltmeter to indicate lamp voltage
SENSOR	J108	Connector for sensor (Liquid or air)
SAMPLER	J109	Connector for sampler (Liquid or air)

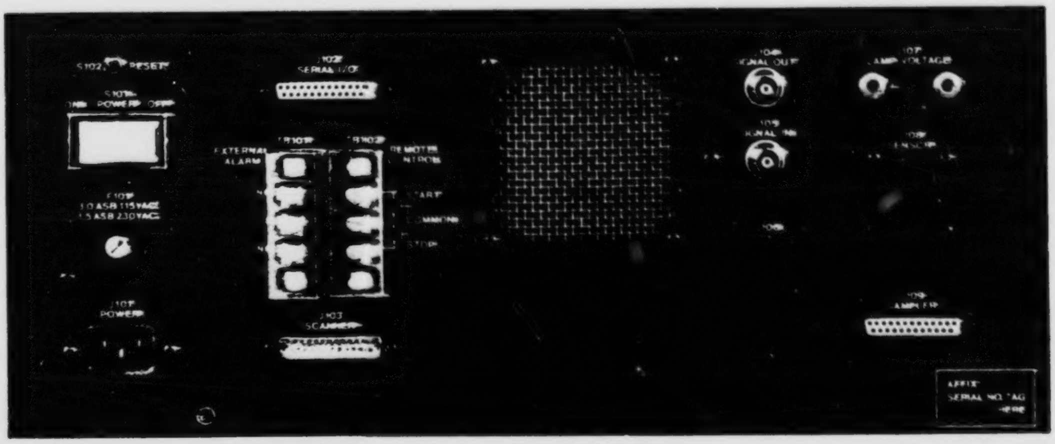


Figure 2-1 MODEL 4100 REAR PANEL

3.2.1 Keyboard

Table 3-1. KEYBOARD (Grouped by Function)

COUNT CONTROL GROUP	
SAMPLE MODE	Selects one of three sample modes displayed above this key:
MANUAL	START/STOP action of sample controlled manually.
TIME	Sample runs controlled by SAMPLE TIME and DELAY TIME timer.
VOLUME	Sample runs controlled by external volume sampler.
CHANNEL ADVANCE	Advances and displays next channel data.
START	Initiates a sample run.
STOP	Terminates a sample run.
MANUAL PRINT	Prints out data of last sample run completed.
* SIZE	Allows entry of particle diameter in relation to channel threshold for printout record.
* NO. OF RUNS	Allows data accumulation of up to 10 runs for averaging.
DELETE	Used with NO. OF RUNS mode. This key is active for 15 seconds at the end of each run. Press during this period to delete data from that run.
* CLOCK	Displays time and date from the 24-hr. time-of-day clock.
* SAMPLE TIME	Active only if TIME MODE is selected, this timer determines the duration of a sample up to 99 minutes and 99 seconds.
* SAMPLE ID	Allows entry of six-digit number to identify a sample run.
* SPECIAL FUNCTION	Used with two numeric keys to select special functions:
00	SYSTEM FAIL or SYSTEM NORMAL BASE LINE FAIL OVERCONCENTRATION CHECKSUM FAILED RAM TEST FAILED BATTERY RAM FAIL BATTERY TEST FAIL CLOCK NOT RUNNING
01	Prints SYSTEM STATUS including all timers, modes of operation, and alarm settings.
02	ALARM CHANnel allows selection of one channel on which alarm limits will be set.
03	STBL DLY Stabilization Delay timer allows up to 99 seconds sample flow stabilization in TIME or MANUAL mode.
04	ELAPSe time indicates time elapse during sample counting.
05	SAMPle VOLume is a three-digit number representing the volume of the sample, and used to divide the data to obtain counts per unit volume.

* On any data key, the first depression displays the data and the second displays the format. At this point new data may be entered through the number keys, ALWAYS FOLLOWED BY E TO ENTER.

CHAPTER 3

OPERATION

3.1 OPERATION DESCRIPTION

The Model 4100 Particle Counter is capable of counting particles suspended in liquids or air. It is configured in such a way that regardless of the mode of operation, all accessories are controlled by the Model 4100. Once the initial set-up adjustments have been made, a single pushbutton controls the system.

3.2 FRONT PANEL CONTROLS AND DISPLAYS

The front panel controls and displays are illustrated in Figure 3-1, and the keyboard is described in Table 3-1.

The CHANNEL THRESHOLD thumbwheels are located on the front panel to the right of the keyboard. Select the particle size threshold for each channel by correlating it with the calibration curve for the particular sensor being used. Arrange thresholds in progressive order so that Channel 1 has the lowest setting and Channel 6 the highest.

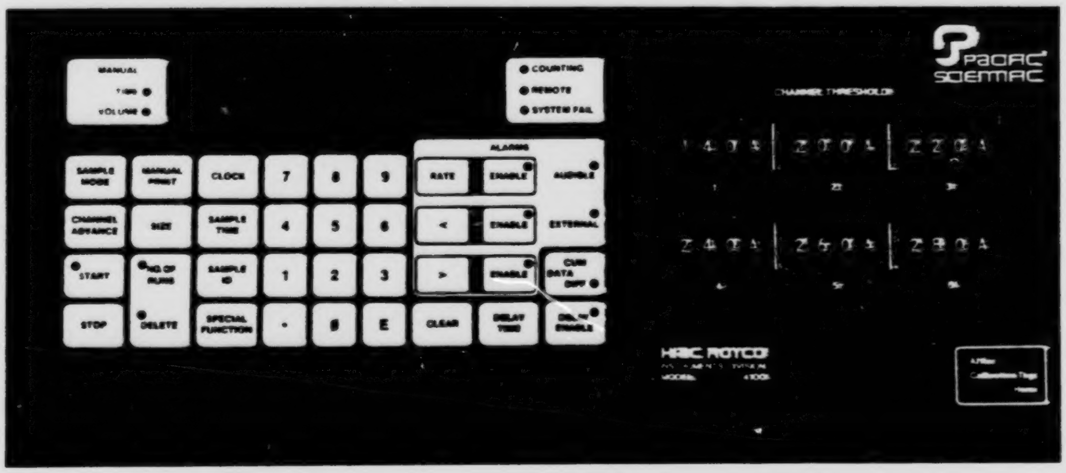


Figure 3-1. Model 4100 Front Panel

3.3 OPERATING PROCEDURE

3.3.1 Power Turn-On

After the power cord has been connected to the appropriate ac outlet, turn on power by pressing the power toggle switch on the rear panel to ON. Approximately 8 seconds of initialization and self testing can be observed in the following sequence:

1. All LEDs turn on and then off.
2. Audible alarm beeps once.
3. All segments of the display turn on and then off.
4. If the optional printer is connected and has its power on, the REMOTE LED turns on and the printer prints out the following:

```
*********************
HIAC/ROYCO
*********************
11/01/82    10:10:36

SELF TEST RESULTS
  CHECKSUM OK
  RAM TEST OK
  BATTERY RAM OK
  BATTERY TEST OK
  CLOCK RUNNING
```

If any of the self tests fail, the Model 4100 sends out a warning signal by flashing the SYSTEM FAIL LED. If this happens, press the SPECIAL FUNCTION key followed by 00 to display the failure.
The SYSTEM FAIL LED remains off during normal operation.

3.3.2 Threshold Settings

The series of CHANNEL THRESHOLD thumbwheels to the right of the keyboard should be set to correlate the selected particle size thresholds with the calibration curve for the particular sensor being used. For example, if Channel 1 is to be set at 5um, find 5um on the horizontal axis of the graph. Note where the 5um line intersects the calibration curve. Read the threshold setting in millivolts (mV) for that point on the verticle axis and enter that number into Channel 1 by adjusting the thumbwheel switches. Follow the same procedure for the other channels, arranging the threshold sizes in progressive order so that Channel 1 has the lowest setting and Channel 6 the highest.

A, B, and C are multipliers of the digits that read directly in millivolts. A = X 0.1, B = X 1, and C = X 10.

EXAMPLE:

$\boxed{1}\boxed{2}\boxed{3}\boxed{A}$ = 12.3mV $\boxed{1}\boxed{2}\boxed{3}\boxed{B}$ = 123mV $\boxed{1}\boxed{2}\boxed{3}\boxed{C}$ = 1230mV

Table 3-1. KEYBOARD (continued)

06	A two-channel display with Channel 1 and a second channel selected through CHANNEL ADVANCE key followed by S.F. 06.
07	CAL ACTIVE/ILLEGAL AIR CAL calibrates the air sensor for 3 seconds and allows it to stabilize for another 3 seconds. If instrument is in COUNT mode when 07 is pressed, counting stops during this 6-second interval and CAL ACTIVE is displayed. ILLEGAL AIR CAL is displayed if no air sensor is connected.
08	ALARM PRINT (YES/NO). Use period key to select. If YES is selected, no printout occurs unless alarm is tripped. (Do not use with Run Averaging.)
09	SHORT PRINT (YES/NO). Use period key to select. If YES is selected, only count data is printed.
10	COMP PRINT (YES/NO) Use period key to select. If YES is selected printout is in computer format.
DATA$^{\text{CUM}}_{\text{DIFF}}$	Selects one of the two data display modes, cumulative or differential. Printout always records both modes.
DELAY TIME	Determines interval between timed sample runs (hrs./mins.)
DELAY ENABLE	Enables DELAY TIMER. LED blinks until START is depressed.
ALARM CONTROL GROUP	
The three different alarms are independent of each other and can be enabled or disabled independently with the corresponding ENABLE key. The ENABLE LED remains on when the associated alarm is enabled, and flashes to indicate that the alarm limit has been exceeded.	
* RATE	Sets count rate limits in particles per minute on alarm channel. (Special Function 02)
* < and >	Less Than (<) and Greater Than (>) keys allow operator to enter alarm limits for the channel selected. (S.F. 02)
AUDIBLE	Enables the audible alarm when an alarm limit is exceeded.
EXTERNAL	Enables the external relay when an alarm limit is exceeded. This relay can be used to control an external alarm.
NUMERIC KEY GROUP	
These keys are used for data entry and for specifying special functions. Data is stored in memory with E (enter) key. Mistakes are cleared with CLEAR key if it is pressed before the data is entered with E key.	
LEDS TO RIGHT OF DISPLAY	
COUNTING	Indicates sample is being counted.
REMOTE	Indicates data is being sent out serially. Keyboard disabled.
SYSTEM FAIL	Flashes if there is a failure condition: during Power-Up SELF TEST (EPROM checksum, RAM, Battery RAM, Battery, Clock) or during counting (Base Line Fail or Overconcentration).

* On any data key, the first depression displays the data and the second displays the format. At this point new data may be entered through the number keys, ALWAYS FOLLOWED BY E TO ENTER.

3.3.4.1 Timed Sample Mode, continued.....

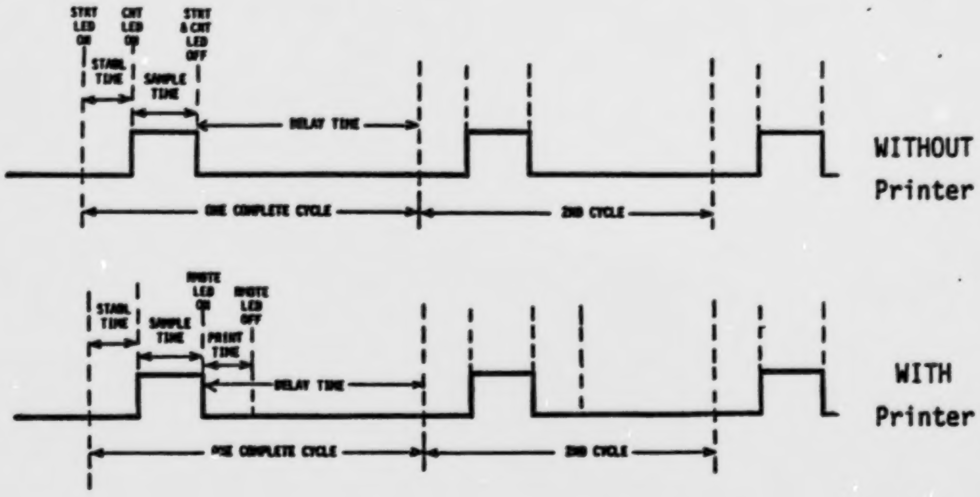
* * * EXAMPLE 2 * * *

Run continual 10 second samples separated by one minute delay time and five second sample stabilization delay time.

1. Use SAMPLE MODE key to select TIME mode.
2. Enter sample time into sample timer: Press SAMPLE TIME key twice, press .10 and then E to enter.
3. To enter stabilization delay time, press SPECIAL FUNCTION 03, press 5 and then E to enter.
4. To enter delay time between samples, press DELAY TIME key twice, press .1 and then E to enter. Turn on DELAY ENABLE LED to enable the delay timer. (LED will flash until START key is pressed.)
5. Press START key to start the first cycle.

The START LED turns on when the START key is pressed. Five seconds later the COUNTING LED turns on and remains on for 10 seconds indicating that the counter is enabled. At the end of 10 seconds both COUNTING LED and START LED turn off. At this point the delay timer controls the system for one minute after which the cycle repeats itself.

If a printer is connected and turned on, the REMOTE LED will turn on at the end of each Sample Time and all else will stop during printout of data.



Timed Sample with Stabilization Delay

3.3.3 Particle Size

Entering particle size in microns for the various channels is optional. You may want print-out documentation or reference on the display of the diameter of particles counted in each channel. To set or re-set, press CHANNEL ADVANCE to call up desired channel; Press SIZE key to see particle size for which channel is currently set; press SIZE key a second time for format; and press number keys (followed by E) to enter the particle diameter which corresponds with the CHANNEL THRESHOLD setting. Repeat for each channel.

3.3.4 Sample Mode

Select the sample mode by pressing the SAMPLE MODE key until the LED is on beside the chosen mode, TIME, VOLUME, or MANUAL.

3.3.4.1 Timed Sample Mode

In the Timed Sample Mode the sample run is controlled by three separate timers, the sample timer which is always used, and stabilization delay timer and delay timer which are not always used. The following examples will illustrate their usage.

* * * EXAMPLE 1 * * *

Run a single timed-sample of one minute and 45 seconds duration.

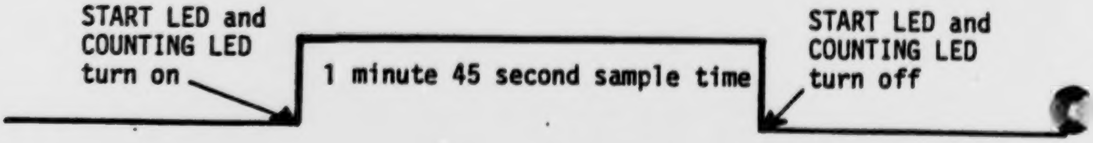
1. Use SAMPLE MODE key to select TIME mode.

2. Enter sample time into sample timer: press SAMPLE TIME key twice and enter 1.45 and then E to enter.

3. To enter stabilization delay time, press SPECIAL FUNCTION 03. Since no stabilization time is being allowed in this example, press zero and then E to enter.

4. The delay timer is not needed in a single sample run. If the LED on the DELAY ENABLE key is on, press this key once to turn it off.

5. Now that the sample time has been stored in the sample timer, the sample run is initiated by pressing the START key and is automatically terminated one minute and 45 seconds later. Notice that the START LED and the COUNTING LED turn on and off simultaneously because of the zero stabilization time.

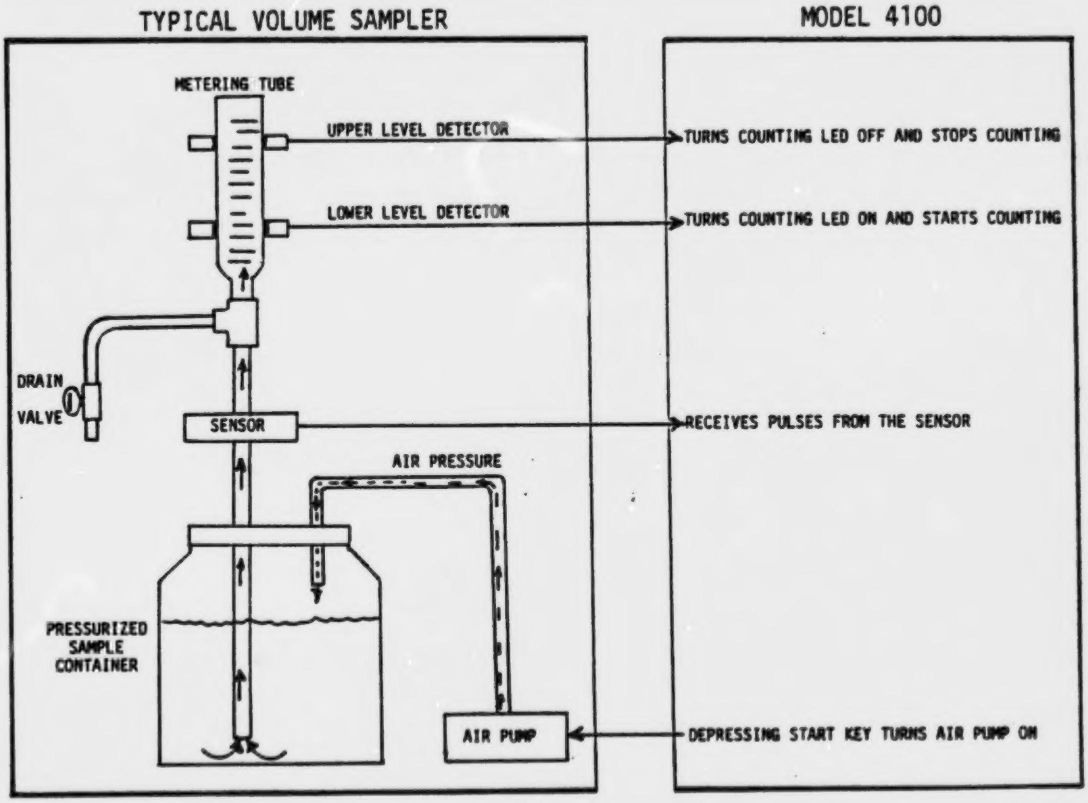


3.3.4.2 Volume Sample Mode

This mode allows the counter to analyze a pre-selected volume of sample. When a volume sampler is connected to the Model 4100, the COUNTING LED on the 4100 is controlled by the sampler.

The volume sampler provides a means of metering a known volume of sample through the sensor and issuing START/STOP COUNTING signals to the Model 4100 Counter. The operating cycle is initiated by depressing the START key on the 4100 or the START key on the sampler if one is provided.

Some samplers are capable of multi-cycle sampling. Refer to the specific sampler manual for detailed sampler description.


TYPICAL VOLUME SAMPLER

MODEL 4100

METERING TUBE
UPPER LEVEL DETECTOR
LOWER LEVEL DETECTOR
TURNS COUNTING LED OFF AND STOPS COUNTING
TURNS COUNTING LED ON AND STARTS COUNTING
DRAIN
VALVE
SENSOR
RECEIVES PULSES FROM THE SENSOR
AIR PRESSURE
PRESSURIZED
SAMPLE
CONTAINER
AIR PUMP
DEPRESSING START KEY TURNS AIR PUMP ON

3.3.4.3 Manual Mode

In Manual Mode the sample run is controlled by the operator using the START and STOP keys. Stabilization Delay Time is the only timer that can be used in this mode.

3.3.4.1 Timed Sample Mode, continued.....

* * * EXAMPLE 3 * * *

Run continual one minute samples with three-run averaging, 20 second sample stabilization time, and 2½ hour delay time between samples.

Steps 1, 2, and 3 are the same as in EXAMPLE 2, except for the times. In this example use 1 for sample time and 20 for stabilization time.

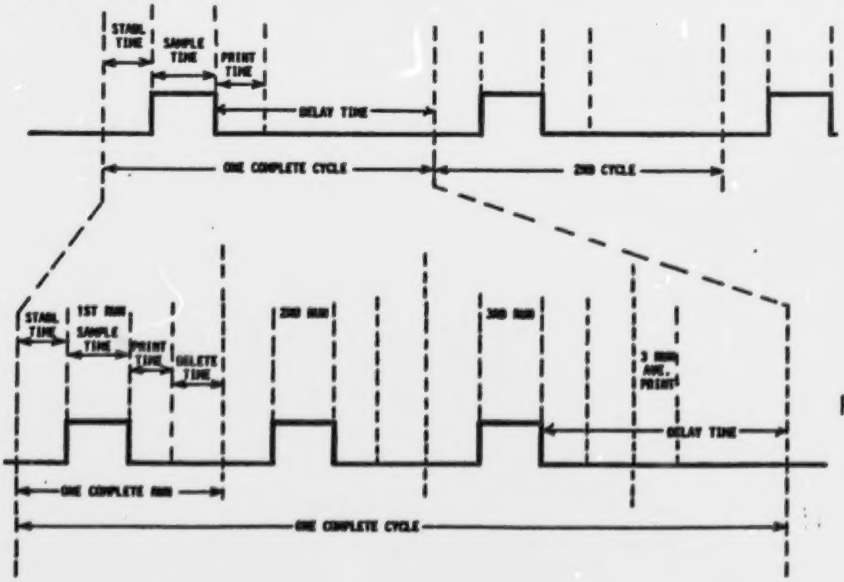
4. To enter run averaging, press NO. OF RUNS key twice, press 3, and then E to enter.

5. Enter delay time between samples: press DELAY TIME key twice, press 2.30 and then E to enter. Turn on DELAY ENABLE LED to enable the delay timer. (LED will flash until START key is pressed.)

6. Press START key to start the first cycle.

The START LED turns on when the START key is pressed. Twenty seconds later the COUNTING LED turns on and remains on for one minute indicating that the counter is enabled. At the end of one minute, both COUNTING LED and START LED turn off and DELETE LED and REMOTE LED turn on. All other functions cease during printout of data. When REMOTE LED turns off, DELETE LED remains on for 15 seconds during which the data for the sample just completed may be deleted by pressing the DELETE key. If the DELETE key is pressed during this time, the printer will print out * RUN DELETED * and a new run will take its place before the runs are averaged.

At the end of the delete interval, the START LED turns on to start the 20 second sample stabilization time for the second run of the cycle. At the end of three runs, the printer prints out the three-run average and the delay timer controls the system for 2½ hours before the next cycle begins.



Timed Sample

WITHOUT

and

WITH

Run Averaging

3.4.3 RATE Alarm Setting for Liquid Sensor

The configuration of the sample cell in the sensor assures that all entering particles pass through the sensitive volume and thus are registered in the count. Although each pulse of current indicates one particle, there is a finite probability that there will be more than one particle in the critical volume at the same time. In this instance, an incorrect count will occur; one apparent large particle will be counted instead of two smaller ones. The error is termed "coincidence error" and is a function of particle concentration in the flow stream. The error due to coincidence increases as particle concentration increases.

The RATE alarm should be used as an overconcentration indicator. Table 3-2 provides both flow rate range and sensor concentration limits for various types and sizes of liquid sensors. Use this table to obtain your nominal flow rate and concentration limit, and figure your rate setting using the following formula:

$$\underset{\text{(mL/min.)}}{\text{NOMINAL FLOW RATE}} \times \underset{\text{(particles/mL)}}{\text{CONCENTRATION LIMIT}} = \text{RATE SETTING}$$

EXAMPLE: For CMB 150 Sensor, nominal flow rate of 100mL/min. and concentration limit of 2000 particles/mL, RATE setting is 200,000.

$$100 \times 2000 = 200{,}000$$

Enter this number on the RATE alarm and enable the alarm. Be sure to use Channel 1 as the Alarm Channel. (S.F. 02)

3.4.4 Liquid Sensor Performance Specifications

Sensors are normally calibrated at their nominal flow rate. Flow rate variations of ± 10% of the nominal value will not materially change the calibration. The E series sensor may be calibrated for any flow rate within ± 50% of the nominal value. When this is done, the new calibration will be valid for flow rates within ± 10% of the new value. For HR Sensors, a ± 10% change in flow rate changes the apparent particle size by ∓ 1.2%.

3.4 ALARMS

Alarms can be used in any of the operation modes. Alarm modes and characteristics are presented here. Other alarm information can be found in Table 1-1, Specifications, and in Table 3-1, Keyboard.

3.4.1 Three alarm modes are available.

1. RATE alarm is triggered when the preset rate in particle counts per minute is exceeded by the alarm channel. (Special Function 02)
2. < alarm is triggered at the end of a complete sample run if cumulative data in the alarm channel is less than the alarm setting.
3. > alarm is triggered at the end of a complete sample run if cumulative data in the alarm channel is greater than the alarm setting.

These three alarms can be individually enabled or disabled. When an alarm limit is exceeded, the associated LED flashes. If the AUDIBLE and/or EXTERNAL alarms have been enabled, they also are activated.

3.4.2 Alarm Characteristics

When activated, the Less Than (<) and the Greater Than (>) alarm limits are compared with the cumulative data in the alarm channel at the end of each sample run.

The RATE alarm monitors the input pulse rate continuously in counts per minute (CPM) during the sample run. To eliminate any false alarm due to a burst of particles passing through the sensor, the 4100 monitors the pulse rate at one of two fixed detection time intervals:

Three-second detection interval for count rate limit over 1000 CPM:

Three seconds detection time is required to detect an overrate condition. If the RATE alarm is tripped, it remains on until one second after the next count period begins. At this time, if the alarm condition no longer exists, the alarm automatically resets itself.

Sixty-second detection interval for count rate limit 1000 CPM or less:

Sixty seconds detection time is required to detect an overrate condition. If the RATE alarm is tripped, it remains on until 20 seconds after the next count period begins. At this time, if the alarm condition no longer exists, the alarm automatically resets itself.

If the Less Than (<) or the Greater Than (>) alarm is tripped, it will reset itself at the end of the following sample time if the count in the alarm channel is within the alarm limit.

These three alarms can be reset any time by manually disabling and then enabling them. If all three alarms are disabled, AUDIBLE and EXTERNAL will be automatically disabled.

The volume on the AUDIBLE alarm is controlled by potentiometer R12 located on top of the Input/Output board.

3.5 INITIATE COUNT

After the thresholds are set, the operation mode selected, peripherals properly connected, and alarms selected, the Model 4100 is ready to count particles. The count cycle begins when the START key is depressed, and continues until the STOP key is depressed in MANUAL mode, until the selected time is reached in TIME mode, or until the preset volume is reached in VOLUME mode. Multi-cycle counting is possible with the DELAY TIMER in TIME and VOLUME modes. (See Section 3.3.4.1)

3.6 OBSERVE DISPLAYED DATA

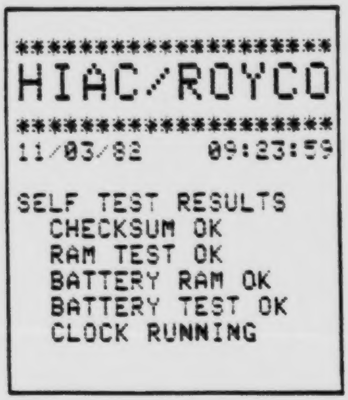
At the completion of a sample run, the data and its channel identification are displayed on the display window. Use the CHANNEL ADVANCE key to observe other channels.

3.7 PRINTOUT

If the optional printer is connected and turned on, count data and other information is printed out automatically at the end of each sample run. Additional copies can be rinted by pressing the MANUAL PRINT key. During the printing operation the REMOTE LED turns on, and all other keyboard functions are disabled.

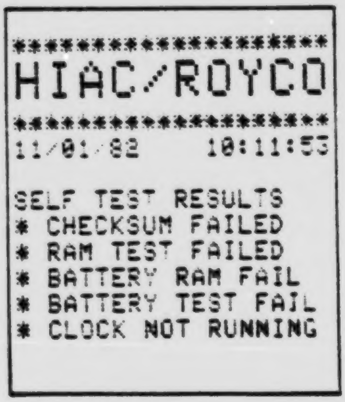
3.7.1 Power-Up Self-Test

If the printer is on when the switch on the rear panel of the 4100 is turned on, the date, time, and self test results will print out. If any one or more of the self-tests fail, it will be indicated on the printout. See Section 5.5 for troubleshooting suggestions.



```
********************
HIAC/ROYCO
********************
11/03/82    09:23:59

SELF TEST RESULTS
  CHECKSUM OK
  RAM TEST OK
  BATTERY RAM OK
  BATTERY TEST OK
  CLOCK RUNNING
```

or



```
********************
HIAC/ROYCO
********************
11/01/82    10:11:53

SELF TEST RESULTS
* CHECKSUM FAILED
* RAM TEST FAILED
* BATTERY RAM FAIL
* BATTERY TEST FAIL
* CLOCK NOT RUNNING
```

Table 3-2. Sensor Flow Rate and Concentration Limits

	SENSOR MODEL NUMBER	DETECTION RANGE (µm)	CONCENTRATION LIMIT (Particles/mL)	FLOW RATE (mL/min.)
STANDARD SENSORS	CMB-120	2 - 120	3,100	40 ± 10
	-150	2½ - 150	2,000	100 ± 50
	-300	5 - 300	500	225 ± 100
	-600	10 - 600	120	900 ± 450
HIGH CONCENTRATION SENSORS	CMH-60	1 - 60	30,000	6 ± 0.6
	-90	1½ - 90	13,000	10 ± 1
	-120	2 - 120	7,500	20 ± 5
	-150	2½ - 150	4,000	50 ± 25
	-300	5 - 300	1,200	100 ± 50
	-600	10 - 600	300	300 ± 150
LARGE PARTICLE SENSORS	E-1000	20 - 1000	35	1,160 ± 800
	-2500	45 - 2500	6	10,600 ± 5,000
	-9000	150 - 9000	0.1	100,000 ± 50,000
SOLVENT SENSORS	JS-60	1 - 60	30,000	6 ± 0.6
	-90	1½ - 90	12,000	10 ± 1
	-120	2 - 120	7,500	20 ± 5
	-150	2½ - 150	4,000	50 ± 25
	-300	5 - 300	1,250	100 ± 50
	-600	10 - 600	300	300 ± 150
ACID SOLVENT SENSORS	JA-60	1 - 60	30,000	6 ± 0.6
	-90	1½ - 90	12,000	10 ± 1
	-120	2 - 120	7,500	20 ± 5
	-150	2½ - 150	4,000	50 ± 25
	-300	5 - 300	1,200	100 ± 50
	-600	10 - 600	300	300 ± 150
HR SENSORS	HR-60H	1 - 60	6,500	10 ± 10%
	-120H	2 - 120	4,500	40 ± 10%
	-300H	5 - 300	900	100 ± 10%
	HR-60	1 - 60	3,500	25 ± 10%
	-120	2 - 120	1,500	100 ± 10%
	-300	5 - 300	400	400 ± 10%

3.7.4 Standard Printout With All Fields

TITLE FIELD -

Prints date, time, and SAMPLE ID. When set at 0, SAMPLE ID is eliminated.

PARAMETERS -

Prints only active parameters. START TIME, ELAPSE time, and SAMPLE MODE are always active; others must be keyed-in.

CONDITIONS -

Indicates system condition. Possible failure conditions are: BASELINE FAIL, OVERCONCENTRATED, and SELF TEST FAIL.

ALARMS -

Prints ALARM status.

SIZES -

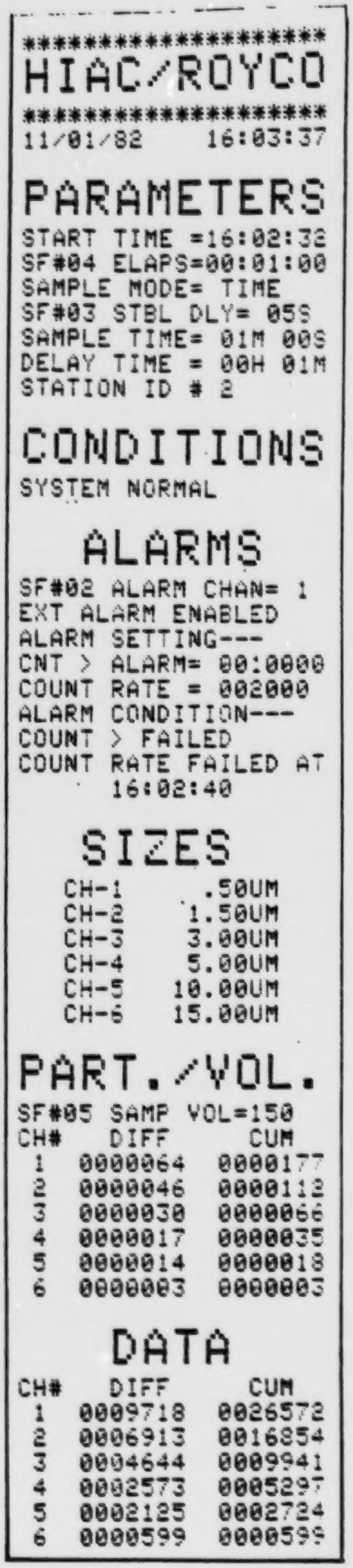
Prints sizes in micrometres. If all sizes are zero, this field is eliminated.

PART./VOL -

Prints particle counts per unit volume. If sample volume is zero, this field is eliminated.

DATA -

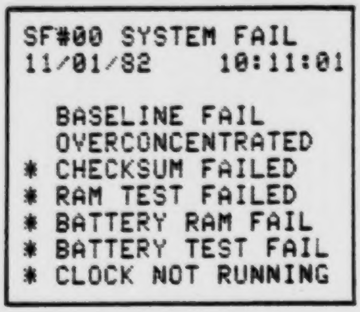
Prints all channels in both DIFFerential and CUMulative mode.



```
********************
HIAC/ROYCO
********************
11/01/82    16:03:37

PARAMETERS
START TIME =16:02:32
SF#04 ELAPS=00:01:00
SAMPLE MODE= TIME
SF#03 STBL DLY= 05S
SAMPLE TIME= 01M 00S
DELAY TIME = 00H 01M
STATION ID # 2

CONDITIONS
SYSTEM NORMAL

   ALARMS
SF#02 ALARM CHAN= 1
EXT ALARM ENABLED
ALARM SETTING---
CNT > ALARM= 00:0000
COUNT RATE = 002000
ALARM CONDITION---
COUNT > FAILED
COUNT RATE FAILED AT
      16:02:40

   SIZES
   CH-1      .50UM
   CH-2     1.50UM
   CH-3     3.00UM
   CH-4     5.00UM
   CH-5    10.00UM
   CH-6    15.00UM

PART./VOL.
SF#05 SAMP VOL=150
CH#   DIFF      CUM
 1  0000064  0000177
 2  0000046  0000112
 3  0000030  0000066
 4  0000017  0000035
 5  0000014  0000018
 6  0000003  0000003

     DATA
CH#   DIFF      CUM
 1  0009718  0026572
 2  0006913  0016854
 3  0004644  0009941
 4  0002573  0005297
 5  0002125  0002724
 6  0000599  0000599
```

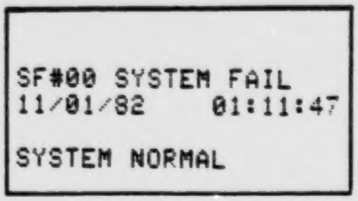
3.7.2 System Fail/System Normal (S.F. 00)

If the SYSTEM FAIL LED to the right of the display window is flashing, press SPECIAL FUNCTION 00 for a printout of the failure condition.



```
SF#00 SYSTEM FAIL
11/01/82    10:11:01

  BASELINE FAIL
  OVERCONCENTRATED
* CHECKSUM FAILED
* RAM TEST FAILED
* BATTERY RAM FAIL
* BATTERY TEST FAIL
* CLOCK NOT RUNNING
```

or

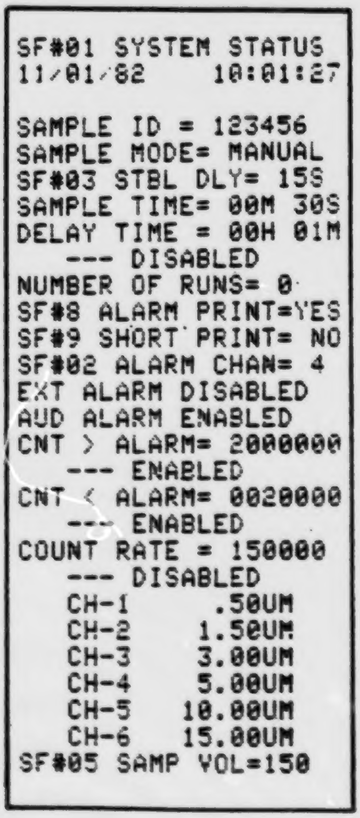


```
SF#00 SYSTEM FAIL
11/01/82    01:11:47

SYSTEM NORMAL
```

when failure has been remedied.

3.7.3 System Status (S.F. 01)

SYSTEM STATUS prints out any time SPECIAL FUNCTION 01 is keyed-in.



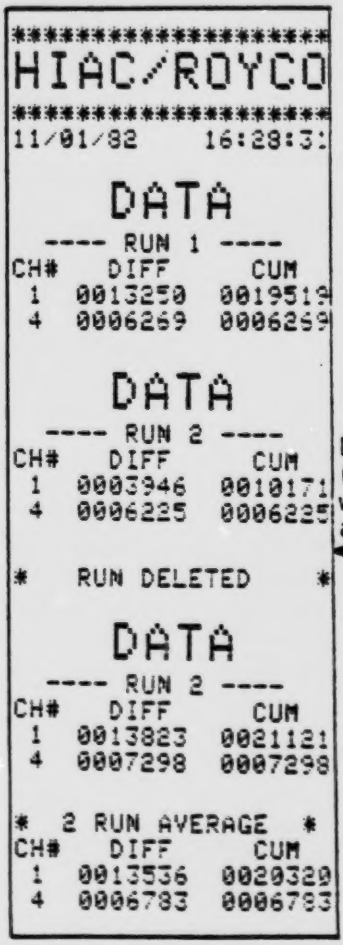
```
SF#01 SYSTEM STATUS
11/01/82    10:01:27

SAMPLE ID = 123456
SAMPLE MODE= MANUAL
SF#03 STBL DLY= 15S
SAMPLE TIME= 00M 30S
DELAY TIME = 00H 01M
   --- DISABLED
NUMBER OF RUNS= 0
SF#8 ALARM PRINT=YES
SF#9 SHORT PRINT= NO
SF#02 ALARM CHAN= 4
EXT ALARM DISABLED
AUD ALARM ENABLED
CNT > ALARM= 2000000
   --- ENABLED
CNT < ALARM= 0020000
   --- ENABLED
COUNT RATE = 150000
   --- DISABLED
    CH-1      .50UM
    CH-2     1.50UM
    CH-3     3.00UM
    CH-4     5.00UM
    CH-5    10.00UM
    CH-6    15.00UM
SF#05 SAMP VOL=150
```

3.7.8 Run Averaging

If NO. OF RUNS is keyed-in for run averaging, data for the selected number of sample runs is printed out followed by the average of those runs.

Any long or short form print mode may be used, but after the printing of the first run, only run number and data for each run is printed until the specified number of runs have been completed and averaged.

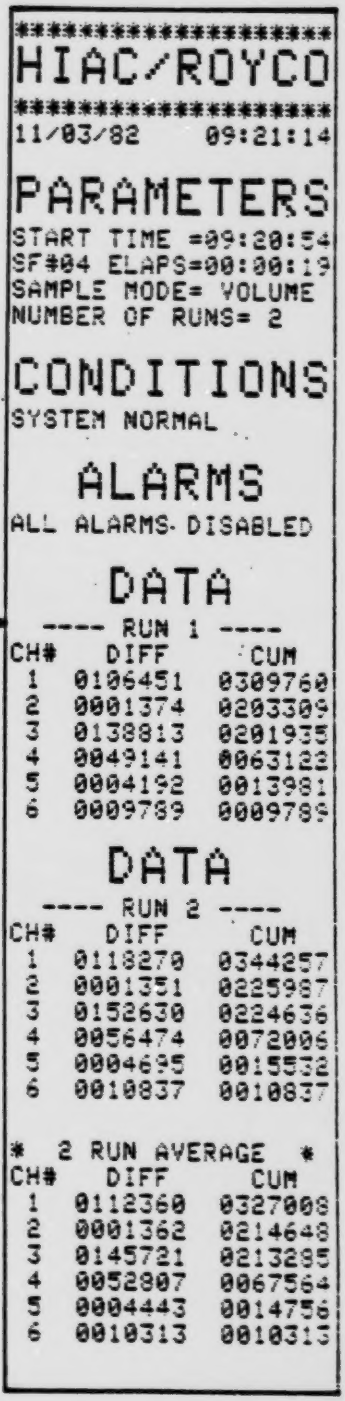
If the DELETE key is pressed during the 15-second Delete time delay after any sample run, data for that run is deleted and * RUN DELETED * printed out before the replacement run.



```
*******************
HIAC/ROYCO
*******************
11/01/82     16:28:3

     DATA
 ---- RUN 1 ----
CH#   DIFF      CUM
 1  0013250  0019519
 4  0006269  0006269

     DATA
 ---- RUN 2 ----
CH#   DIFF      CUM
 1  0003946  0010171
 4  0006225  0006225

*   RUN DELETED    *

     DATA
 ---- RUN 2 ----
CH#   DIFF      CUM
 1  0013823  0021121
 4  0007298  0007298

*  2 RUN AVERAGE  *
CH#   DIFF      CUM
 1  0013536  0020320
 4  0006783  0006783
```

Dual-Channel -
(S.F. 06)
with Run-Averaging
and one run deleted

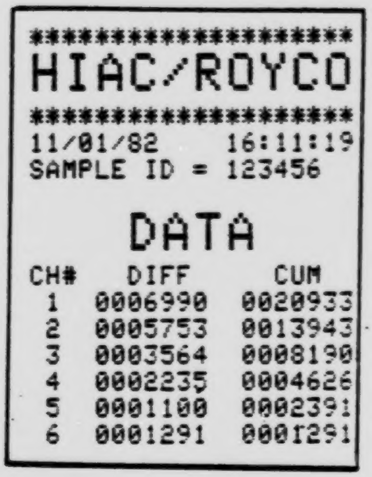
Standard Long Form
with Run-Averaging



```
*******************
HIAC/ROYCO
*******************
11/03/82     09:21:14

PARAMETERS
START TIME =09:20:54
SF#04 ELAPS=00:00:19
SAMPLE MODE= VOLUME
NUMBER OF RUNS= 2

CONDITIONS
SYSTEM NORMAL

     ALARMS
ALL ALARMS DISABLED

     DATA
 ---- RUN 1 ----
CH#   DIFF      CUM
 1  0106451  0309760
 2  0001374  0203309
 3  0138813  0201935
 4  0049141  0063122
 5  0004192  0013981
 6  0009789  0009789

     DATA
 ---- RUN 2 ----
CH#   DIFF      CUM
 1  0118270  0344257
 2  0001351  0225987
 3  0152630  0224636
 4  0056474  0072006
 5  0004695  0015532
 6  0010837  0010837

*  2 RUN AVERAGE  *
CH#   DIFF      CUM
 1  0112360  0327008
 2  0001362  0214648
 3  0145721  0213285
 4  0052807  0067564
 5  0004443  0014756
 6  0010313  0010313
```

3.7.5 Standard Short Print (S.F. 09)

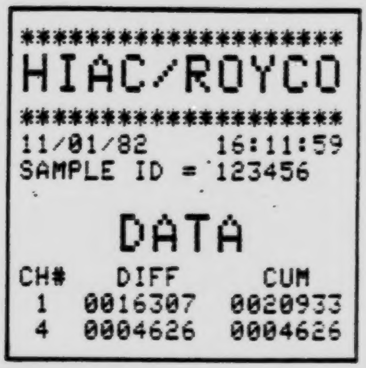
SPECIAL FUNCTION 09 permits selection of the standard SHORT PRINT format which prints out only the TITLE FIELD and the DATA field.



```
********************
HIAC/ROYCO
********************
11/01/82    16:11:19
SAMPLE ID = 123456

      DATA
CH#   DIFF     CUM
 1  0006990  0020933
 2  0005753  0013943
 3  0003564  0008190
 4  0002235  0004626
 5  0001100  0002391
 6  0001291  0001291
```

3.7.6 Dual-Channel (S.F. 06)

If Special Function 06 is keyed-in, only data for Channel 1 and a second selected channel are printed out. Select second channel through the CHANNEL ADVANCE key followed by S.F. 06.
(Short form only)



```
********************
HIAC/ROYCO
********************
11/01/82    16:11:59
SAMPLE ID = 123456

      DATA
CH#   DIFF     CUM
 1  0016307  0020933
 4  0004626  0004626
```

3.7.7 Alarm Print (S.F. 08)

SPECIAL FUNCTION 08 can be used with any long or short print format, but there will be no printout unless an alarm condition occurs.

Helpful hint:

When using ALARM PRINT with a short form print mode, it might help to start with a SYSTEM STATUS printout (S.F. 01) as a point of reference.

This reduced copy of the KEYBOARD Table may be cut out and posted on or near the 4100 for quick and easy reference.

Table 3-1. KEYBOARD (Grouped by Function)

COUNT CONTROL GROUP	
SAMPLE MODE MANUAL TIME VOLUME	Selects one of three sample modes displayed above this key: START/STOP action of sample controlled manually. Sample runs controlled by SAMPLE TIME and DELAY TIME timer. Sample runs controlled by external volume sampler.
CHANNEL ADVANCE	Advances and displays next channel data.
START	Initiates a sample run.
STOP	Terminates a sample run.
MANUAL PRINT	Prints out data of last sample run completed or stops print out if printer is running.
* SIZE	Allows entry of particle diameter in relation to channel threshold for printout record.
* NO. OF RUNS	Allows data accumulation of up to 10 runs for averaging.
DELETE	Used with NO. OF RUNS mode. This key is active for 15 seconds at the end of each run. Press during this period to delete data from that run.
* CLOCK	Displays time and date from the 24-hr. time-of-day clock.
* SAMPLE TIME	Active only if TIME MODE is selected, this timer determines the duration of a sample up to 99 minutes and 99 seconds.
* SAMPLE ID	Allows entry of six-digit number to identify a sample run.
* SPECIAL FUNCTION	Used with two numeric keys to select special functions:
00	SYSTEM FAIL or SYSTEM NORMAL BASE LINE FAIL OVERCONCENTRATION CHECKSUM FAILED RAM TEST FAILED BATTERY RAM FAIL BATTERY TEST FAIL CLOCK NOT RUNNING
01	Prints SYSTEM STATUS including all timers, modes of operation, and alarm settings.
02	ALARM CHANnel allows selection of one channel on which alarm limits will be set.
03	STBL DLY Stabilization Delay timer allows up to 99 seconds sample flow stabilization in TIME or MANUAL mode.
04	ELAPSe time indicates time elapse during sample counting.
05	SAMPle VOLume is a three-digit number representing the volume of the sample, and used to divide the data to obtain
06	A two-channel display with Channel 1 and a second channel selected through CHANNEL ADVANCE key followed by S.F. 06.
07	CAL ACTIVE/ILLEGAL AIR CAL calibrates the air sensor for 3 seconds and allows it to stabilize for another 3 seconds. If instrument is in COUNT mode when 07 is pressed, counting stops during this 6-second interval and CAL ACTIVE is displayed. ILLEGAL AIR CAL is displayed if no air sensor is connected.
08	ALARM PRINT (YES/NO). Use period key to select. If YES is selected, no printout occurs unless alarm is tripped. (Do not use with Run Averaging.)
09	SHORT PRINT (YES/NO). Use period key to select. If YES is selected, only count data is printed.
10	COMP PRINT (YES/NO) Use period key to select. If YES is selected printout is in computer format.
DATA$^{CUM}_{DIFF}$	Selects one of the two data display modes, cumulative or differential. Printout always records both modes.
DELAY TIME	Determines interval between timed sample runs (hrs./mins.)
DELAY ENABLE	Enables DELAY TIMER. LED blinks until START is depressed.
ALARM CONTROL GROUP	
The three different alarms are independent of each other and can be enabled or disabled independently with the corresponding ENABLE key. The ENABLE LED remains on when the associated alarm is enabled, and flashes to indicate that the alarm limit has been exceeded.	
* RATE	Sets count rate limits in particles per minute on alarm channel. (Special Function 02)
* < and >	Less Than (<) and Greater Than (>) keys allow operator to enter alarm limits for the channel selected. (S.F. 02)
AUDIBLE	Enables the audible alarm when an alarm limit is exceeded.
EXTERNAL	Enables the external relay when an alarm limit is exceeded. This relay can be used to control an external alarm.
NUMERIC KEY GROUP	
These keys are used for data entry and for specifying special functions. Data is stored in memory with E (enter) key. Mistakes are cleared with CLEAR key if it is pressed before the data is entered with E key.	
LEDS TO RIGHT OF DISPLAY	
COUNTING	Indicates sample is being counted.
REMOTE	Indicates data is being sent out serially. Keyboard disabled.
SYSTEM FAIL	Flashes if there is a failure condition: during Power-Up SELF TEST (EPROM checksum, RAM, Battery RAM, Battery, Clock) or during counting (Base Line Fail or Overconcentration).

* On any data key, the first depression displays the data and the second displays the format. At this point new data may be entered through the number keys, ALWAYS FOLLOWED BY E TO ENTER.

SPECIAL FUNCTION CHART

for quick and easy reference

* SPECIAL FUNCTION	Used with two numeric keys to select special functions:
00	SYSTEM FAIL or SYSTEM NORMAL BASE LINE FAIL OVERCONCENTRATION CHECKSUM FAILED RAM TEST FAILED BATTERY RAM FAIL BATTERY TEST FAIL CLOCK NOT RUNNING
01	Prints SYSTEM STATUS including all timers, modes of operation, and alarm settings.
02	ALARM CHANnel allows selection of one channel on which alarm limits will be set.
03	STBL DLY Stabilization Delay timer allows up to 99 seconds sample flow stabilization in TIME or MANUAL mode.
04	ELAPSe time indicates time elapse during sample counting.
05	SAMPle VOLume is a three-digit number representing the volume of the sample, and used to divide the data to obtain counts per unit volume.
06	A two-channel display with Channel 1 and a second channel selected through CHANNEL ADVANCE key followed by S.F. 06.
07	CAL ACTIVE/ILLEGAL AIR CAL calibrates the air sensor for 3 seconds and allows it to stabilize for another 3 seconds. If instrument is in COUNT mode when 07 is pressed, counting will stop during this 6-second interval and CAL ACTIVE will be displayed. ILLEGAL AIR CAL is displayed if no air sensor is connected.
08	ALARM PRINT (YES/NO). Use period key to select. If YES is selected, no printout will occur unless alarm is tripped.
09	SHORT PRINT (YES/NO). Use period key to select. If yes is selected, only count data is printed.
10	COMP PRINT (YES/NO) Use period key to select. If YES is selected printout is in computer format.

---

* On any data key, the first depression displays the data and the second displays the format. At this point new data may be entered through the number keys, ALWAYS FOLLOWED BY E TO ENTER.

4.1.6 Input/Output PCB Assembly (530-0006)

The Input/Output PCB contains all interface circuitry for peripherals. It includes circuits for sensor logic, air sensor calibration, battery backed-up RAM, time-of-day clock, Asynchronous Communication Interface Adapter (ACIA) to convert data from parallel to serial in the standard RS232C format, Sonalert beeper, and a relay for external alarm.

4.1.7 Optional PCB

A transducer interface board allows the measurement of temperature, relative humidity, and air velocity, and can receive serial commands from a computer or terminal.

4.2 SYSTEM SOFTWARE

The Model 4100 system software is stored in 16k bytes of EPROM memory which is installed on the Central Processing Unit PCB. The system software uses 1k bytes of RAM and 256 bytes of battery-backed RAM for temporary storage and program housekeeping for controlling the system.

When power is applied to the Model 4100, the software undergoes approximately eight seconds of self-testing and hardware initialization. The self-test results are sent out serially to a printer or a computer, then the keyboard is read and is ready to accept commands.

Self-testing includes LED test, Sonalert (audible alarm) test, Display test, EPROM checksum, RAM test, battery RAM test, battery test, clock test, base line test, and overconcentration test. The last two tests are active during counting time to insure the accuracy of data. Counts are accumulated in 10 millisecond intervals. This interval is also used as the time unit for all timers in the Model 4100.

In addition to accumulating pulses, the software constantly reads the keyboard, updates the display, calculates for alarm conditions and data averaging, provides periodic calibration of air sensor, responds to the Interrupt Request (IRQ) from the sampler, advances the scanner to its next station, and transmits data to a serial device.

CHAPTER 4

OPERATING PRINCIPLES

This section contains a brief description of the major functions of the Model 4100 sub-assemblies and the system software.

4.1 SUB-ASSEMBLIES

The following sub-assemblies are grouped according to their function in the instrument.

4.1.1 Deck Mounting Assembly (100-7483)

The deck mounting assembly consists of a mother board and two power supplies. Connectors J1, J2, J3, and J4 on the motherboard are connected in parallel. The system power supply provides regulated 5 Vdc at 3 amps and ±15 Vdc at 0.8 amps. The lamp power supply provides the voltage and current required by the sensor. Maximum available current is 6 amps dc.

4.1.2 Front Panel Assembly (100-7484)

The front panel assembly consists of a keyboard, a display board, and thumbwheel switches for setting channel thresholds. The display board contains interface circuitry for the keyboard, alphanumeric display, and LEDs.

4.1.3 Rear Panel Assembly (100-7482)

The rear panel assembly contains the power connectors, fuse, test points for the lamp voltage, and peripheral connectors.

4.1.4 Counter PCB Assembly (530-0003)

The counter PCB receives the analog signal from the sensor, screens the input pulses into six different levels, and converts them into digital form which can be read and stored in memory by the processor.

4.1.5 Central Processing Unit (CPU) PCB Assembly (532-0002)

The central processing unit contains a 6502 microprocessor, Erasable and Programmable Read Only Memory (EPROM), Random Access Memory (RAM) for scratchpad and housekeeping memory usage, address decode logic, system clock, and reset circuitry.

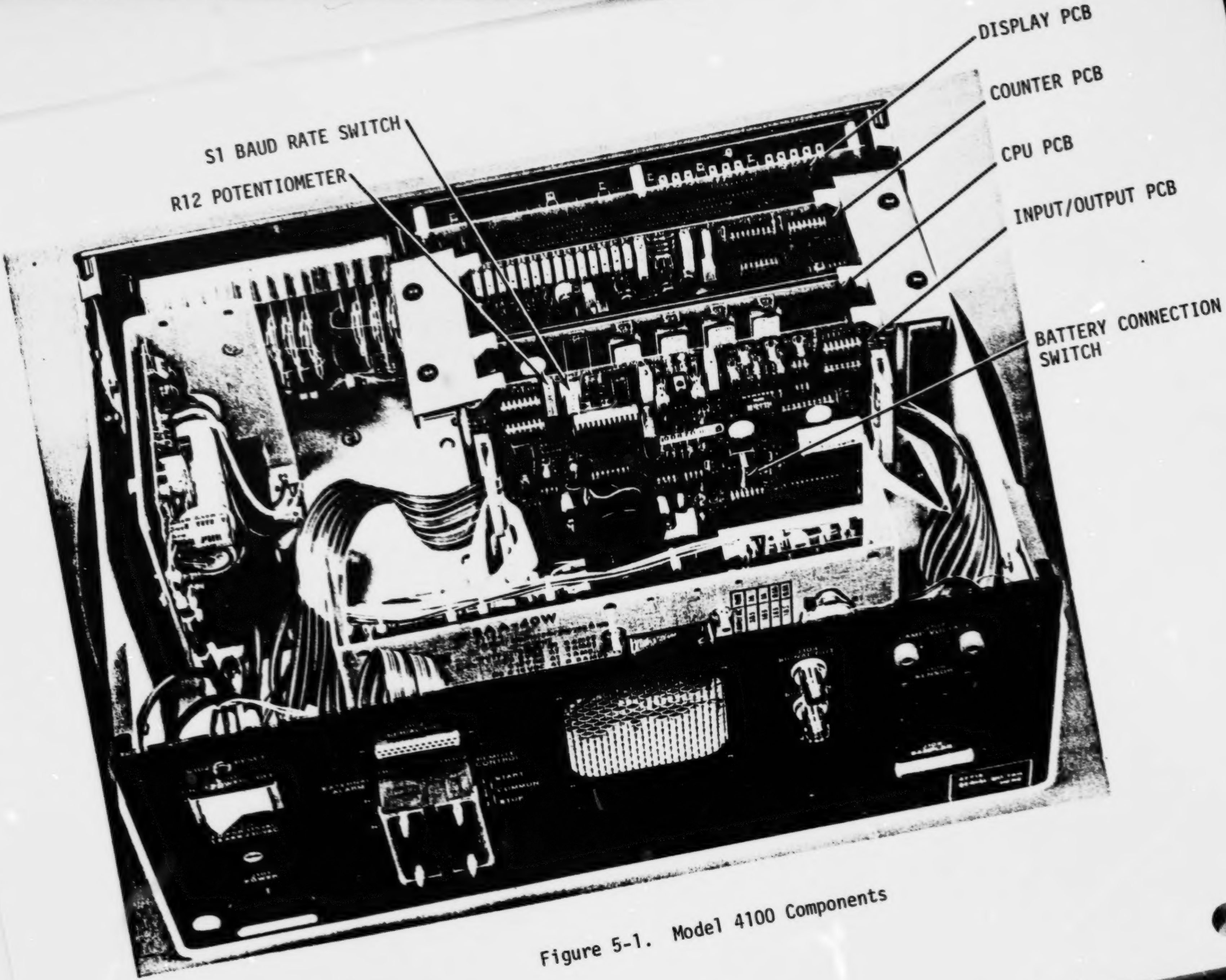


Figure 5-1. Model 4100 Components

~~5.2.2 Card Cage Lifting~~

1. ~~Unscrew the card lock-downs.~~
2. ~~Carefully pivot the card cage and latch it against the stop.~~
3. ~~To lower the card cage press the latch located under the PCBs and lower the card cage to the storage position.~~
4. ~~Lock the card cage down by securing it with the locking screws.~~

5.2.3 Cleaning

* * * ALWAYS TURN POWER OFF BEFORE CLEANING * * *

To clean the outside surfaces of the equipment, use a damp lint-free cloth or a vacuum cleaner.

NOTE: Do not use freon-based solvents to clean the 4100 cover or PCBs. Use of freon may damage the cover and some components installed on the PCBs.

5.3 PERFORMANCE CHECK

The following areas must be checked to verify the proper operation of the 4100 and its peripherals.

Powerup	Apply power to the 4100. Check the results against the sequences described in Section 3.3.1 Power Turn-On. This verifies the operation of the display, keyboard LEDs, and all other self-test functions.
Keyboard	Exercise all the modes and selections described in Section 3.2.1 Keyboard. This will verify that all keys operate correctly.
Audible Device	Cause the alarm to trip, and then enable and disable the AUDIBLE key. This should cause an interruption in the audible beep. Adjust the volume with R12 on the Input/Output board.
Internal Relay	Cause the alarm to trip. Enable and disable the EXTERNAL key and listen to the relay click.
Remote Control	Perform START/STOP operation using the REMOTE CONTROL terminal (TB102) on the rear panel to verify this function.
Particle Counting	Make a sample run to verify the communication between the sensor and the 4100.

CHAPTER 5

MAINTENANCE AND TROUBLESHOOTING

This chapter contains information pertaining to user oriented maintenance and troubleshooting of the Model 4100.

5.1 PRECAUTIONS

During operation of the Model 4100 certain precautions should be observed to avoid injury to the operator or damage to the equipment.

1. Always turn OFF the system when removing or installing cables.

2. Always turn OFF the system and remove the power cord before removing the top cover.

3. Always use a three-prong grounded plug when operating the 4100 and all other equipment associated with it. Never use a "cheater" plug to disconnect the ground terminal of the supplied power cords.

4. When moving the equipment from one place to another, remove all connections between the instruments to prevent accidental damage to the cables, equipment, or operator. When reconnecting the cables, be sure they are secured properly.

5. Because much of the circuitry of Model 4100 and associated equipment contains Metal Oxide Semiconductor (MOS) devices, static charge must be avoided. Never work on the equipment in an area charged with static energy, such as a carpeted room.

   When removing the top cover and handling the PCBs, touch a grounded surface first to discharge any charge which may have built up on your body.

6. Whenever moving or carrying the Model 4100, use both handles.

5.2 USER MAINTENANCE

5.2.1 Cover Removal

To remove the Model 4100 top cover:

1. Turn the power OFF and remove the plug.

2. Remove the four screws which secure the top cover to the base plate.

3. Lift off the top cover.

5.5 SELF CHECK PROBLEMS

When the Self Check feature of the Model 4100 indicates that there is a potential problem with a portion of the system, the SYSTEM FAIL LED flashes and the failure is printed out.

Some of these may be minor problems which will correct themselves, or they may be problems which only trained service personnel can fix.

SELF TESTS

EPROM Checksum	This test verifies that all bits of the system program contained in the EPROM add up to a preset value indicating that the program is intact.
Failure Correction:	There is no user serviceable correction. Refer problem to the HIAC/ROYCO Service Department.
RAM Test	This test checks that all bits of the 1K Byte of RAM located on the Interface PCB of the 4100 are operating correctly.
Failure Correction:	There is no user serviceable correction. Refer problem to the HIAC/ROYCO Service Department.
Battery RAM Test	This test verifies that all 256 bytes of the battery backed-up RAM on the 4100 Interface PCB are operating correctly.
Failure Correction:	There is no user serviceable correction. Refer problem to the HIAC/ROYCO Service Department.
Battery Test	This test checks to make sure that the battery used to power the CMOS RAM and the clock has not lost its charge.
Failure Correction:	The problem may be that the battery has lost its charge during shipping or storage for an extended period. To verify that there is no other problem press RESET on the rear panel and see whether the test passes this time. Leave the unit on for several hours or overnight to charge the battery. After this turn the unit off, wait 30 seconds, then turn on and see whether the test passes. If it fails, check the I/O PCB and verify that the battery connection switch is in the ON position. If the test still fails, refer the problem to the service department.

5.3 Performance Check, continued.....

Sampler Control	Connect a sampler to the 4100. Check the START/STOP operation of the pump and the COUNTING LED on the 4100.
Serial Port	Connect a serial printer and verify that the serial port is operating correctly. Refer to Section 5.4 if there are any problems.
Model 160/161	Connect a Model 160/161 to the 4100 and run a sample. Check that the Station ID is printed in the Parameters Field. This verifies that the 160 interface circuitry is functional. Model 160 requires approximately 30 seconds purge delay time before the sample is valid. Use Stabilization Delay timer, SF 03.

5.4 SERIAL COMMUNICATION PROBLEMS

Below is a check list of common serial communication problems.

Pinouts	Are the signals provided by the connector on the the receiving device the same as provided by the 4100? Check your pinouts against those shown in Section 5.7 REAR PANEL CONNECTOR WIRING.
Baud Rate	Are the Baud rates set correctly? See Section 2.2.3 Baud Rate Selection for setting instructions. Refer to the Operation Manual for the receiving device for the set-up procedure.
Data Format	Does the receiver conform to the data formats shown in Table 1-1 Serial Output Data? If the receiver has another format, communications may not occur. The device must be set to conform with the data format provided by the 4100.
Handshaking	When data are available, the Model 4100 brings the Request To Send (RTS) line to high (+15V) and waits for the Clear To Send (CTS) signal from the receiving device. Serial time-out failure will occur if the CTS signal is not available within 30 seconds after the RTS line goes to high. The receiving device must provide logic high (+5V or +15V) to pin 20 (TERMINAL READY) for serial communication.

5.6 Common Problems and Solutions, continued.....

3. PROBLEM Same data on all channels.

   SOLUTION Check the threshold settings and ranges (A, B, C). They should be set in progressive order (at least 0.5mV apart) so that Channel 1 has the lowest number and range setting and Channel 6 the highest.

4. PROBLEM Start the counter and the START LED turns on, but the COUNT LED remains off.

   SOLUTION Check the Stabilization Delay Timer (S.F. 03), Volume Sampler connections and Volume Level Detectors.

5. PROBLEM Alarm does not trip, or it trips too soon.

   SOLUTION Check alarm limits and Alarm Channel (S.F. 02). Always display data in the cumulative mode. Re-read Section 3.4.2, Alarm Characteristics.

6. PROBLEM START LED/STOP LED toggle every 0.6 seconds.

   SOLUTION Press any key on the keyboard to get out of this mode. It is used for threshold calibration in the factory and has no use for the operator. It was entered by pressing SPECIAL FUNCTION, CLEAR, and DELETE keys. Avoid this sequence.

7. PROBLEM Keyboard does not respond.

   SOLUTION Note whether the REMOTE LED is on, indicating that the counter is outputting data. When REMOTE LED turns off, the unit is ready to accept key input.

8. PROBLEM Special Function 00 displays "SYSTEM FAIL" but no failure is displayed or printed out.

   SOLUTION "SYSTEM FAIL" is displayed to indicate that SF 00 has been keyed in, but the COUNT LED is on. No message is displayed or printed until the COUNT LED turns off.

9. PROBLEM Special Function 01 displays "SYSTEM STATUS", but no information is printed.

   SOLUTION "SYSTEM STATUS" is displayed to indicate that SF 01 has been keyed in, but the COUNT LED is on. When the COUNT LED turns off, the remote printer prints the system status.

10. PROBLEM Special Function 01 displays Channel data.

    SOLUTION Check printer and its power connections.

11. PROBLEM Calendar/clock year does not advance automatically.

    SOLUTION Set it manually. HAPPY NEW YEAR!

5.5 Self Check Problems, continued.....

Clock Test	This test makes sure the clock is running normally after the power has been applied.
Failure Correction:	Power ON/OFF may cause the clock to run in a fast mode. If this happens, reset the clock and then press the RESET button on rear panel. A rundown battery may cause the clock to stop. First reset the clock, and then press RESET button on rear panel. If this remedies the problem, let the battery charge and cycle the power. If the same failure occurs after the battery has charged and the Battery Test passes, refer problem to the service department.
Sensor Base Line Test	While the counter is counting, it continuously monitors the sensor baseline to stay within ±600mV.
Failure Correction:	When baseline tolerance is exceeded, first try cleaning the sensor. If the problem still exists refer it to the service department.
Mainframe Overconcentration Test	This test makes sure that the input pulse rate is within the limit allowed. This limit is approximately 1.5 million counts per minute.
Failure Correction:	A failure may be caused by the setting of Channel 1 threshold being too low. Make sure Channel 1 threshold setting is above the noise level of the sensor. If it still fails, refer the problem to the service department.

5.6 COMMON PROBLEMS AND SOLUTIONS

Below is a list of common problems associated with operator error. The problem and its probable cause are presented.

1. PROBLEM	No printout at end of sample run.
SOLUTION	Check printer power and connection cables. Printer Baud rate should agree with the 4100. If Special Function 08 is set to YES, there is no printout unless there is an alarm condition.
2. PROBLEM	Count LED indicates counting, but no data is being displayed.
SOLUTION	Check threshold settings and the data display mode (Cumulative or Differential).

5.7 REAR PANEL CONNECTION WIRING

	PIN NO.	SIGNAL	FUNCTION	DIRECTION
J102 SERIAL I/O	1,7	GND	Digital Ground	—
	2	$\overline{\text{RXD}}$	Receive Data	INPUT
	3	$\overline{\text{TXD}}$	Transmit Data	OUTPUT
	4	CTS	Clear to Send (high)	INPUT
	18	$\overline{\text{CTS}}$	Clear to Send (low)	INPUT
	5	RTS	Request to Send	OUTPUT
	6,8	DTR	Data Terminal Ready	OUTPUT
	20	TR	Terminal Ready	INPUT
J103 SCANNER	9	GND	Digital Ground	—
	10	PRINT	Station Advance	OUTPUT
	25	Q1	Station ID 1's Bit	INPUT
	24	Q2	Station ID 2's Bit	INPUT
	23	Q4	Station ID 4's Bit	INPUT
	22	Q8	Station ID 8's Bit	INPUT
J108 SENSOR	5	GND	Digital Ground	—
	14	GND	Analog Ground	—
	6	+15V	Power to Cal. Motor	OUTPUT
	4	+15V	Power	OUTPUT
	2	-15V	Power	OUTPUT
	9	CAL MOTOR	Cal. Motor Control	OUTPUT
	11	H.V. CNTRL	High Voltage Control	OUTPUT
	7	SIGNAL IN	Analog Signal	INPUT
	8	LAMP DRIVE	Power to Lamp	OUTPUT
	1	LAMP RETURN	Power Return From Lamp	—
	10	+LAMP VOLT	Lamp Voltage Reference	INPUT
	3	-LAMP VOLT	Lamp Voltage Reference	INPUT
	12	LOGIC CNTRL 12	Sensor Type 1's Bit	INPUT
	13	LOGIC CNTRL 13	Sensor Type 2's Bit	INPUT
J109 SAMPLER	6	GND	Digital Ground	—
	7	GND	Digital Ground	—
	20	GND	Digital Ground	—
	8	GND	Digital Ground	—
	2	SAMPLER GND	Sampler Ground	—
	19	+5V	Power	OUTPUT
	14	+15V	Power	OUTPUT
	16	-15V	Power	OUTPUT
	22	PUMP START	20mA Current Out	OUTPUT
	1	PUMP CONTROL	20mA Current In	INPUT
	3	CNT	Count, 20mA In	INPUT
	17	$\overline{\text{MULTICYCLE ENABLE}}$	Sampler Type	INPUT
	21	$\overline{\text{SAMPLER CONNECTED}}$	Service Request	INPUT
	4	ASAP ON/OFF	To ASAP Sampler	OUTPUT
	5	AIR PUMP ENABLE	To Air Sensor	OUTPUT
	15	COMPARATOR OUT	To Air Sensor	OUTPUT
	18	ATTN BY-PASS	To CLS Sampler	OUTPUT

6.1 COMPUTER CONTROL COMMANDS, continued.....

4100 Key	REMOTE COMMAND		4100 WILL RESPOND IN THE FOLLOWING FORMAT	REMARK
SAMPLE TIME	T	CR	!THM.SS	READ SAMPLE TIME
	T10.30	CR	!T10.30	SET SAMPLE TIME = 10 MIN 30 SEC
DELAY TIME	DT	CR	!DTHH.MM	READ DELAY TIME
	DT1.25	CR	!DT1.25	SET DELAY TIME = 1 HR 25 MIN
DELAY ENABLE	D	CR	!D±	DELAY TIME ENABLED (+) " " DISABLE (-)
	D±	CR	!D±	EXPLICIT ENABLE (+) OR DISABLE (-) OF DELAY TIME
RATE ENABLE	R	CR	!R±	ALARM RATE ENABLED (+) " " DISABLE (-)
	R±	CR	!R±	EXPLICIT ENABLE (+) OR DISABLE (-) OF RATE ALARM
< ENABLE	L	CR	!L±	ALARM < ENABLED (+) " < DISABLE (-)
	L±	CR	!L±	EXPLICIT ENABLE (+) OR DISABLE (-) OF ALARM LESS THAN
> ENABLE	G	CR	!G±	ALARM > ENABLED (+) " > DISABLE (-)
	G±	CR	!G±	EXPLICIT ENABLE (+) OR DISABLE (-) OF ALARM GREATER THAN
AUDIBLE	A	CR	!A±	AUDIBLE ENABLED (+) " DISABLE (-)
	A±	CR	!A±	EXPLICIT ENABLE (+) OR DISABLE (-) OF AUDIBLE ALARM
EXTERNAL	E	CR	!E±	EXTERNAL ENABLED (+) " DISABLE (-)
	E±	CR	!E±	EXPLICIT ENABLE (+) OR DISABLE (-) OF EXTERNAL ALARM
DATA	DD	CR	!DDC !DDD	DATA= CUMULATIVE (C) DATA= DIFFERENTIAL (D)
	DDC DDD	CR CR	!DDC !DDD	SET DATA TO CUMULATIVE (C) " " " DIFFERENTIAL (D)
RATE	RA	CR	!RAXXXXXX	READ ALARM RATE SETTING
	RA123456	CR	!RA123456	SET ALARM RATE TO 123456 CPM
<	LA	CR	!LAXXXXXXX	READ ALARM LESS THEN SETTING
	LA1234567	CR	!LA1234567	SET ALARM LESS THAN TO 1234567 COUNTS
>	GA	CR	!GAXXXXXXX	READ ALARM GREATER THAN SETTING
	GA7654321	CR	!GA7654321	SET ALARM GREATER THAN TO 7654321 COUNTS
SF#02	SF02	CR	!SF02X	READ ALARM CHANNEL
	SF024	CR	!SF024	SET ALARM CHANNEL TO 4

CHAPTER 6

REMOTE COMPUTER CONTROL OPTION

The Remote Computer Control Option provides communication to and from a remote computer through the standard RS232C serial interface format. The computer operator is able to set up parameters for the 4100 from a remote location. He can also send a message to the 4100 display screen and know that the message has been received when an operator at the 4100 location depresses the CHANNEL ADVANCE key to clear it. Special Function 10 allows printout in computer format.

6.1 COMPUTER CONTROL COMMANDS

CR = CARRIAGE RETURN
+ = ENABLED
- = DISABLED

4100 Key	REMOTE COMMAND		4100 WILL RESPOND IN THE FOLLOWING FORMAT	REMARK
	REMOTE±	CR	!REMOTE±	COMMAND REMOTE CONTROL FROM THE COMPUTER BY REMOTE ENABLE (+) OR REMOTE DISABLE (-) YOU CAN DISABLE THE REMOTE CONTROL FROM THE 4100 BY A COLD RESTART ONLY.
SAMPLE MODE	M	CR	!MM !MT !MV	MODE= MANUAL MODE= TIME MODE= VOLUME
	MM MT MV	CR CR CR	!MM !MT !MV	SET MODE TO MANUAL " " " TIME " " " VOLUME
START	S	CR	!S	MANUAL START
STOP	H	CR	!H	MANUAL HALT
NO. OF RUNS	N	CR	!NXX	READ NUMBER OF RUNS
	N07	CR	!N07	SET NUMBER OF RUNS TO 07
DELETE	ND	CR	!ND+ !ND !ND-	DELETE TIME FOR NUMBER OF RUNS IS ACTIVE RUN DELETE COMMANDED DELETE TIME EXPIRED
CLOCK	C	CR	!CMM/DD/YY HH:MM:SS	READ 4100 DATE/TIME
	C10.02.82 12.30	CR	!C10.02.82 12.30	SET CLOCK TO 2 OCT 82 12:30
SAMPLE ID	I	CR	!IXXXXXX	READ SAMPLE ID
	I123456	CR	!I123456	SET SAMPLE ID = 123456

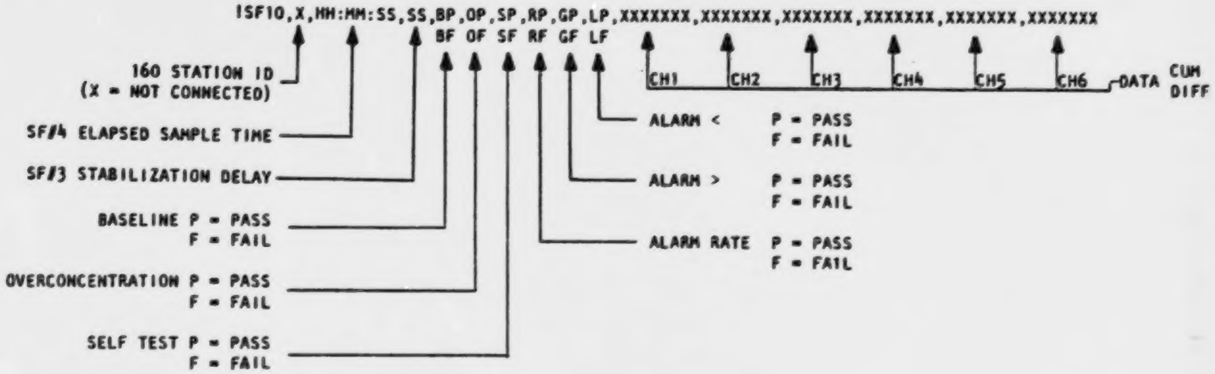
6.2 PRINTOUT FORMATS

6.2.1 PRINTOUTS WITH COMPUTER FORMAT DISABLED (SF10-)

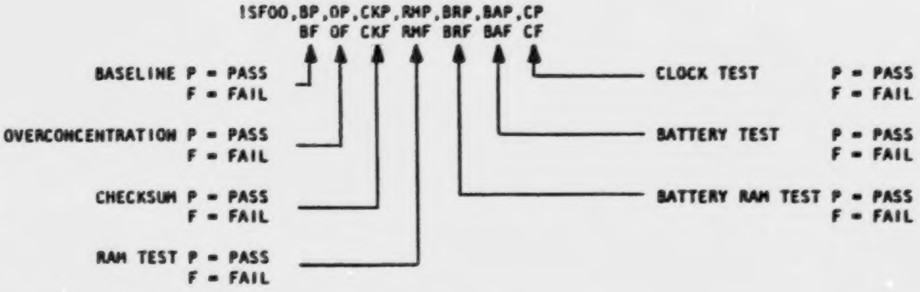
All printouts are in standard 4100 format when computer format is disabled.

6.2.2 PRINTOUTS WITH COMPUTER FORMAT ENABLED (SF10+)

6.2.2.1 OUTPUT OF EACH RUN



6.2.2.2 SPECIAL FUNCTION 00 OUTPUT



6.1 COMPUTER CONTROL COMMANDS, continued.....

4100 KEY	REMOTE COMMAND		4100 WILL RESPOND IN THE FOLLOWING FORMAT	REMARK
SF#03	SF03	CR	!SF03SS	READ STABILIZATION DELAY
	SF0345	CR	!SF0345	SET STABILIZATION DELAY = 45 SEC
SF#04	SF04	CR	!SF04HH:MM:SS	READ ELAPSED SAMPLE TIME
SF#05	SF05	CR	!SF05XXX	READ SAMPLE VOLUME
	SF05150	CR	!SF05150	SET SAMPLE VOLUME = 150
SF#07	SF07	CR	!SF07+ !SF07-	COMMAND CALIBRATE (CAL ACTIVE (+)) (ILLEGAL CAL OR CAL OFF (-))
SF#08	SF08	CR	!SF08±	PRINT ON ALARM ONLY ENABLED (+) " " " " DISABLE (-)
	SF08±	CR	!SF08±	EXPLICIT ENABLE (+) OR DISABLE (-) OF ALARM ONLY PRINT
SF#09	SF09	CR	!SF09±	SHORT PRINT FORMAT ENABLED (+) SHORT PRINT FORMAT DISABLE (-)
	SF09±	CR	!SF09±	EXPLICIT ENABLE (+) OR DISABLE (-) OF SHORT PRINT FORMAT
SF#10	SF10	CR	!SF10±	COMPUTER PRINT FORMAT ENABLED (+) COMPUTER PRINT FORMAT DISABLE (-)
	SF10±	CR	!SF10±	EXPLICIT ENABLE (+) OR DISABLE (-) OF COMPUTER PRINT F
MANUAL PRINT	P	CR	!P ....DATA....	PRINT DATA
SF#00	SF00	CR	!SF00 ....SF00....	PRINT SYSTEM FAILS
SF#01	SF01	CR	!SF01 ....SF01....	PRINT SYSTEM STATUS
	ILLEGAL COMMAND		?	COMMAND ILLEGAL (WRONG FORMAT)
	RESET	CR		MODEL 4100 MASTER RESET
				TEST TO SEE IF THE 4100 DISPLAY BUFFER IS ACTIVE
	"	CR	!"" !"ECHO MESSAGE"	MESSAGE BUFFER IS NOT ACTIVE MESSAGE BUFFER IS ACTIVE
	"SEND MESSAGE"	CR	!"SEND MESSAGE"	OUTPUT MAXIMUM OF 40 CHARACTER MESSAGE FROM THE REMOTE COMPUTER/TERMINAL TO THE MODEL 4100 DISPLAY
	""	CR	!""	DELETE THE MESSAGE FROM THE 4100 DISPLAY.

6.3 DISPLAYS

All LEDs will be used as they are currently implemented. The 4100 display, while in the REMOTE MODE, will be in a single channel format. The channel diaplayed will be the one on the display when the REMOTE MODE was entered.

The local indication for the REMOTE MODE active will be an "R" in the 20th display position of the 4100.

CH-4 XXXXXXX   R

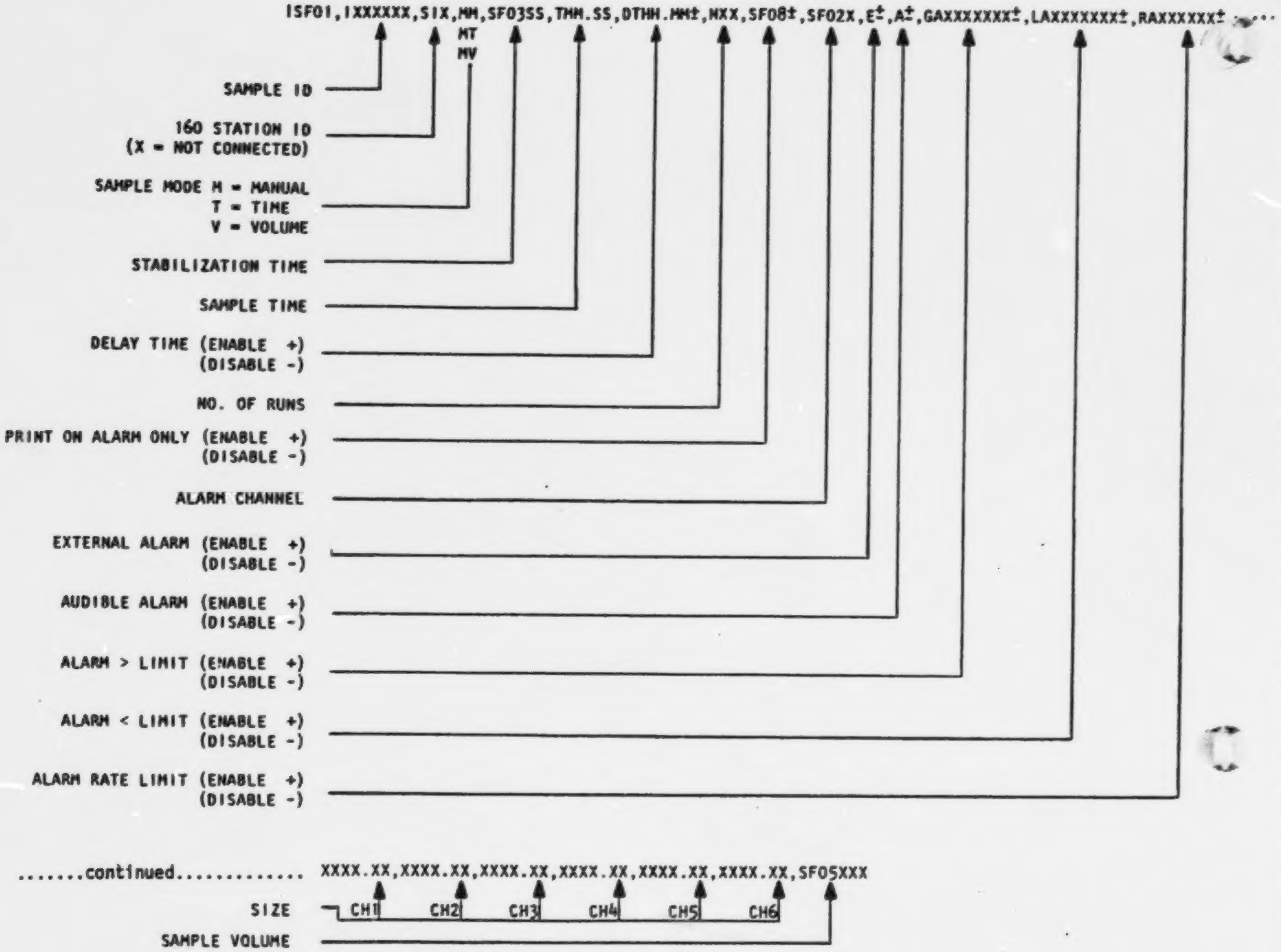
6.4 MESSAGE TRANSMISSION

The remote computer terminal may send a message to the Model 4100 display. The person at the Model 4100 can read the message and then clear it by depressing the CHANNEL ADVANCE key. (This will enable a new message to be sent.) The display will then advance to the next channel and give the one-channel count display.

SET CH-1 THLD TO 275A

The Model 4100 CHANNEL ADVANCE key is always active to allow the local display to show the count data on any channel.

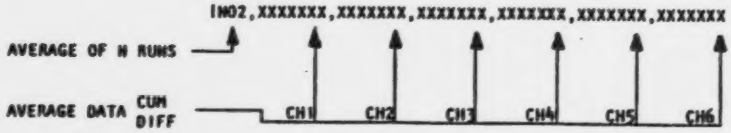
6.2.2.3 SPECIAL FUNCTION 01 OUTPUT



6.2.2.4 NUMBER OF RUNS ENABLED

EXAMPLE: Average of two data runs requested.

```
ISF10 . . . . DATA . . (1st RUN)

ISF10 . . . . DATA . . (2nd RUN)

IND-                   DELETE RUN KEY DEPRESSED

ISF10 . . . . DATA. . (2nd RUN)

IN02,XXXXXXX,XXXXXXX,XXXXXXX,XXXXXXX,XXXXXXX,XXXXXXX
```

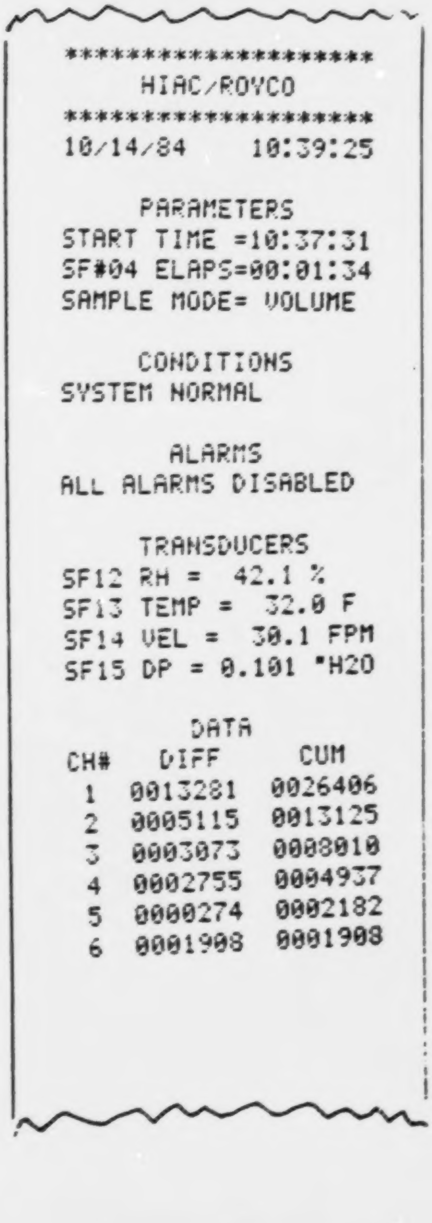


7.4 PRINTOUT WITH TRANSDUCERS

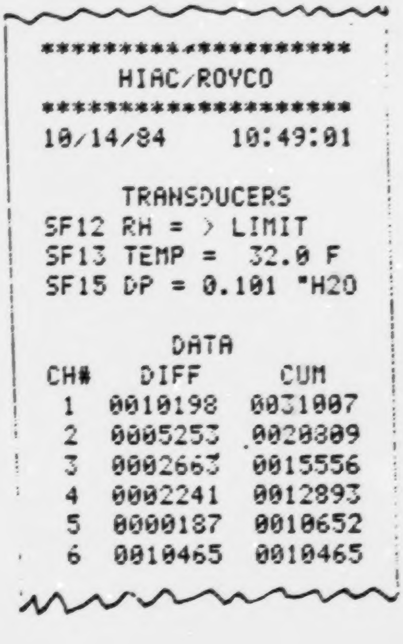
Data is printed only for transducers that are connected during the sample run. If no transducer is connected, the entire section (including title) is omitted.
Transducer data is NOT averaged when system is in Run Averaging Mode (NO. OF RUNS key).

7.4.1 PRINTOUTS WITH NO COMPUTER

All printouts are in standard 4100 format when there is no computer or when computer format is disabled (SF10-). The following printouts are examples of a standard long form with four transducers connected and a standard short form with three transducers connected.



```
********************
     HIAC/ROYCO
********************
10/14/84     10:39:25

     PARAMETERS
START TIME =10:37:31
SF#04 ELAPS=00:01:34
SAMPLE MODE= VOLUME

     CONDITIONS
SYSTEM NORMAL

       ALARMS
ALL ALARMS DISABLED

     TRANSDUCERS
SF12 RH =  42.1 %
SF13 TEMP =  32.0 F
SF14 VEL =  30.1 FPM
SF15 DP = 0.101 "H20

        DATA
CH#   DIFF     CUM
 1  0013281  0026406
 2  0005115  0013125
 3  0003073  0008010
 4  0002755  0004937
 5  0000274  0002182
 6  0001908  0001908
```



```
********************
     HIAC/ROYCO
********************
10/14/84     10:49:01

     TRANSDUCERS
SF12 RH = > LIMIT
SF13 TEMP =  32.0 F
SF15 DP = 0.101 "H20

        DATA
CH#   DIFF     CUM
 1  0010198  0031007
 2  0005253  0020809
 3  0002663  0015556
 4  0002241  0012893
 5  0000187  0010652
 6  0010465  0010465
```

CHAPTER 7

4100AT/4150AT ANALOG TRANSDUCER

7.1 GENERAL DESCRIPTION

The 4100AT/4150AT Analog Transducer is an expanded version of the 4100/4150 Particle counter. It is used primarily with the aerosol sensors. This instrument will accept up to four transducer signal inputs: humidity, temperature, air velocity, and differential pressure. Incoming data is processed and displayed in the same manner as in the standard 4100/4150.

The 4100AT may be operated from a remote control keyboard via an RS232C interface communications system.

7.2 SPECIAL FUNCTIONS ADDITIONS

The 4100AT/4150AT has six more Special Functions than the 4100/4150. The additional Special Functions are:

*SPECIAL FUNCTION	Used with two numeric keys to select special functions:
10	COMPUTER PRINT (YES/NO). Use period key to select. If YES is selected, printout is in computer format.
11	Valid in REMOTE mode only.
12	Displays RELATIVE HUMIDITY transducer value.
13	Displays TEMPERATURE transducer value.
14	Displays AIR VELOCITY transducer value.
15	Displays DIFFERENTIAL PRESSURE transducer value.

*On any data key, the first depression displays the data and the second displays the format. At this point new data may be entered through the number keys, ALWAYS FOLLOWED BY E TO ENTER.

7.3 TRANSDUCER INTERFACE PCB 530-0024

The transducer PCB consists of two sections, the signal converter and the Option RAM PCB replacement for RS232C communications.

7.5 COMPUTER CONTROL COMMANDS

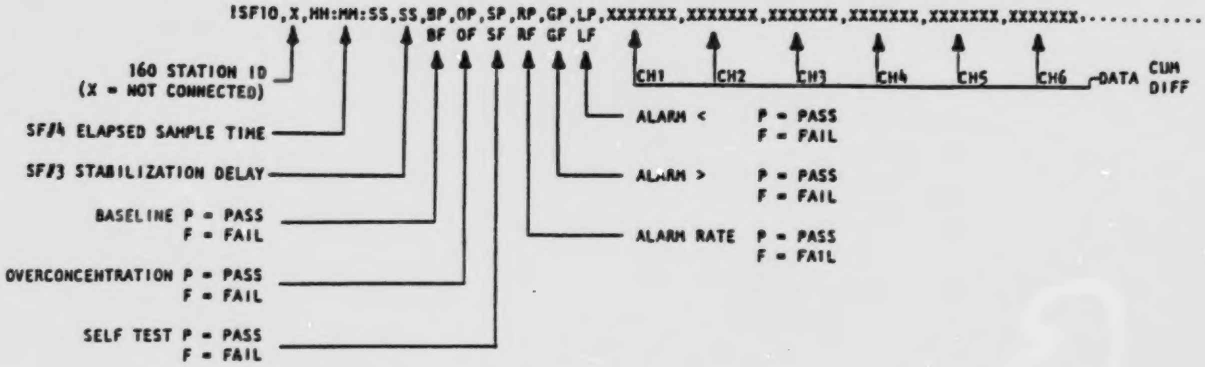
Remote computer control communication is possible through the standard RS232C serial interface format. The computer control commands for the 4100AT/4150AT are as follows:

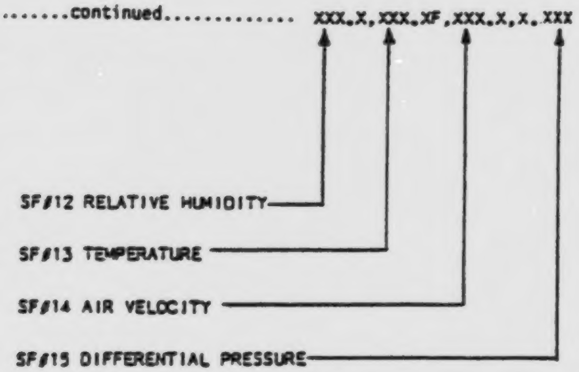
CR = CARRIAGE RETURN
+ = ENABLED
- = DISABLED

4100 KEY	REMOTE COMMAND	4100AT RESPONSE	REMARK
	SF11 CR	!SF11±	AUDIBLE AND EXTERNAL ALARMS ACTIVATED (+) OR DEACTIVATED (-)
	SF11± CR	!SF11±	IMMEDIATE ACTIVATION (+) OR DEACTIVATION (-) OF AUDIBLE AND EXTERNAL ALARMS INDEPENDENT OF NORMAL ALARM FUNCTION CHANNEL ADVANCE KEY ON COUNTER ALSO DEACTIVATES SF11
SF12	SF12 CR	!SF12050.0	RELATIVE HUMIDITY = 50.0%
		!SF12XXX.X	RELATIVE HUMIDITY TRANSDUCER NOT CONNECTED
		!SF12RRR.R	RELATIVE HUMIDITY TRANSDUCER OVER INPUT VOLTAGE LIMIT
SF13	SF13 CR	!SF13022.0F	TEMPERATURE = 22.0 FAHRENHEIT
		!SF13-05.5C	TEMPERATURE = -5.5 CELSIUS SWITCH ON TRANSDUCER PCB SELECTS SCALE: ON = C OFF = F
		!SF13XXX.X	TEMPERATURE TRANSDUCER NOT CONNECTED
		!SF13RRR.R	TEMPERATURE TRANSDUCER OVER INPUT VOLTAGE LIMIT
SF14	SF14 CR	!SF14030.5	AIR VELOCITY = 30.5 FEET PER MINUTE
		!SF14XXX.X	AIR VELOCITY TRANSDUCER NOT CONNECTED
		!SF14RRR.R	AIR VELOCITY TRANSDUCER OVER INPUT VOLTAGE LIMIT
SF15	SF15 CR	!SF150.010	DIFFERENTIAL PRESSURE = TEN THOUSANTHS OF AN INCH OF WATER
		!SFX.XXX	DIFFERENTIAL PRESSURE TRANSDUCER NOT CONNECTED
		!SF14R.RRR	DIFFERENTIAL PRESSURE TRANSDUCER OVER INPUT VOLTAGE LIMIT

7.4.2 PRINTOUTS WITH COMPUTER

The computer output of each run with transducers and computer format enabled (SF10+)is as follows:




.......continued............. XXX.X,XXX.XF,XXX.X,X.XXX
SF#12 RELATIVE HUMIDITY
SF#13 TEMPERATURE
SF#14 AIR VELOCITY
SF#15 DIFFERENTIAL PRESSURE

1.4 GENERAL OPERATING PRECAUTIONS

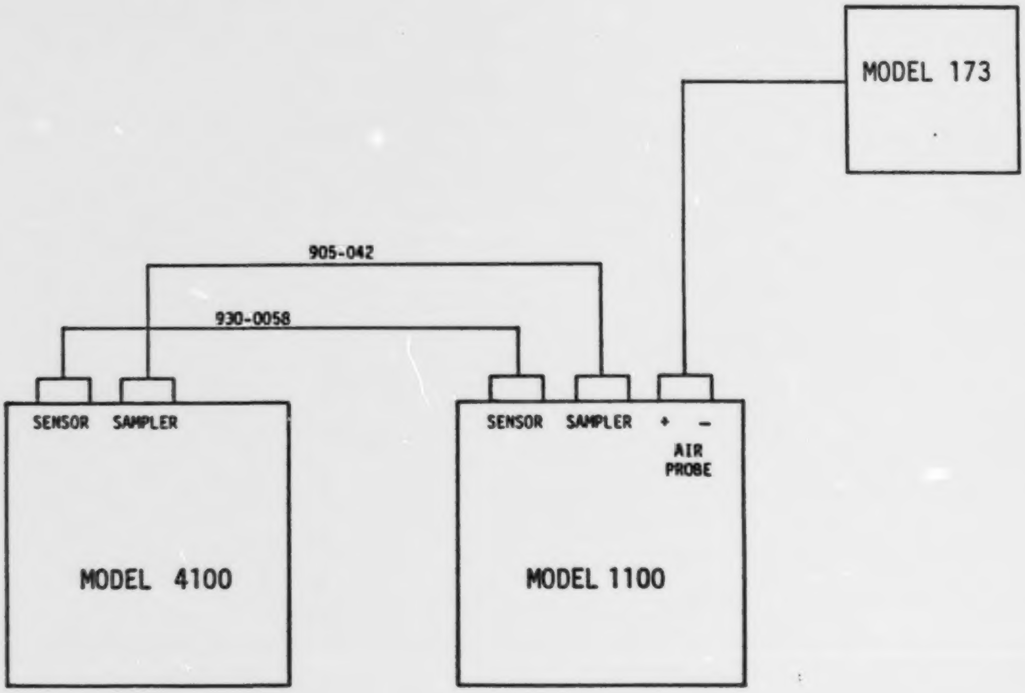
During the operation of the equipment, certain precautions must be taken to avoid injury to the operator or damage to the equipment.

a. Avoid disconnecting the individual units from one another, or removing circuit boards while power is on. In the case of power supply circuit boards, allow 3 to 5 seconds time for the power supply capacitors to discharge after turning off the power.

b. Use extreme care to avoid bodily contact with the electrical components in the equipment. There are high operating voltages such as on the high voltage power supply and on the photomultiplier tube socket in the sensor.

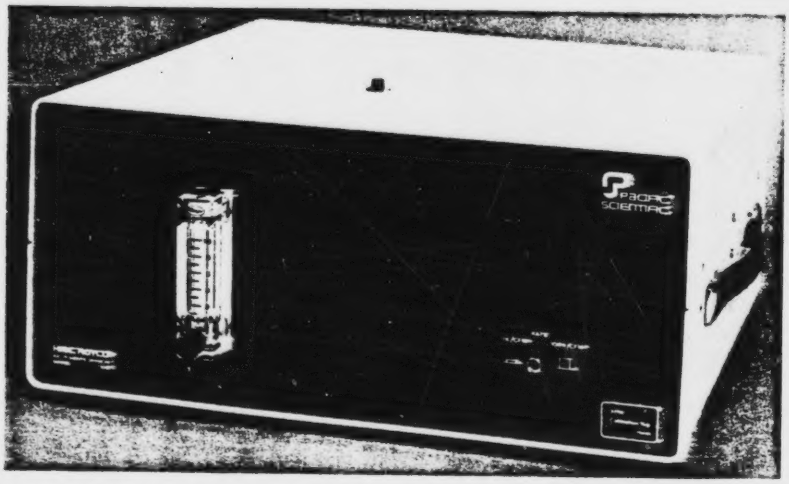
c. While storing the equipment, moving it, or working in its vicinity, be careful to avoid allowing inadvertant entry of liquids or excessive contamination into the sample cell. If the lenses within the cell have particles on them, the noise level in the sensor output signal will increase above an acceptable level. The sensor must be returned to the factory for cleaning. It is advisable to keep the sensor sample inlet tube covered with a plastic cover when it is not in use.

1.5 SYSTEM INTERCONNECT DIAGRAM



APPENDIX A

MODEL 1100 AEROSOL SENSOR



1.1 GENERAL INFORMATION

The Model 1100 Aerosol Sensor is an instrument for sensing particles in a gaseous media and developing a data signal to be used by the Model 4100 Particle Counter. It is used typically in ambient air, in manufacturing installations, or in research laboratories.

1.2 PERFORMANCE SPECIFICATIONS

SAMPLE FLOW RATE	1.0 cubic feet/minute
PARTICLE CONCENTRATION	to 300,000 per cubic foot
PARTICLE SIZE	0.5 micrometre (μm) and larger
SIZING ACCURACY	Stated size, ±5%, based on pulse height measurement.

1.3 DESCRIPTION

The Model 1100 Sensor contains all components necessary to detect the particles and generate the corresponding data signal pulse. It contains the aerosol sampling cell, the light source, the optics, the photomultiplier tube, and an air pump, all of which together generate the data signal. It also contains the calibrate motor and two circuit boards associated with the operation of the photomultiplier tube: a high voltage power supply board and a preamplifier board.

A third dual-function circuit board is contained in the Model 1100. It is the analog rate generator used in conjunction with the Model 173 Air Probe. The signal pulses are converted to a direct current (dc) which drives an analog meter in the Sample Probe. A front panel RATE switch selects two full scale ranges, 1000 or 100,000 particles per cubic foot. The other function is the operation of the automatic calibrate solenoid.

1.6 OPERATION

a. Verify that the Model 1100 is connected to the Model 4100 Counter correctly. Make sure that the flexible tubing, if used, is properly connected and that airflow will not be restricted.

b. Turn on the Model 4100 power switch first. Allow the sensor and the counter to temperature stabilize for 5 minutes.

c. Turn on the Model 1100 power switch and allow another 5 minutes for temperature stabilization.

d. After ten minutes has elapsed, the system will automatically calibrate. After calibration the system is in an operational mode.
NOTE: Every ten minutes an auto calibration will occur for six seconds.

1.7 FLOW RATE

The flow rate is factory pre-set and the range meter will indicate any change in flow rate by a deviation from the normal scale reading. The meter indicates the actual flow rate.

* * * IMPORTANT NOTE * * *

When installing the Model 173 Sampling Probe, use the accompanying manual with the following exception:

Plug the dual electrical connector into the "external meter" jacks on the rear panel of the sensor. The connector with the red wire should go into the (+) jack and the black wire into the (-) jack.

1.4 GENERAL OPERATING PRECAUTIONS

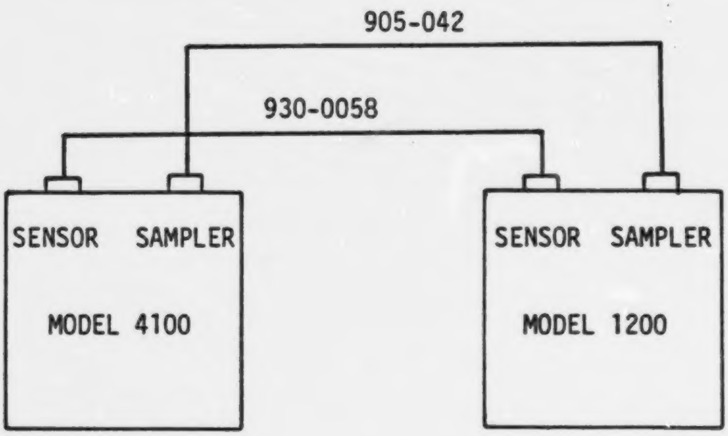
During the operation of the equipment, certain precautions must be taken to avoid injury to the operator or damage to the equipment.

a. Avoid disconnecting the individual units from one another, or removing circuit boards while power is on. In the case of power supply circuit boards, allow 3 to 5 seconds time for the power supply capacitors to discharge after turning off the power.

b. Use extreme care to avoid bodily contact with the electrical components in the equipment. There are high operating voltages such as on the high voltage power supply and on the photomultiplier tube socket in the sensor.

c. While storing the equipment, moving it, or working in its vicinity, be careful to avoid allowing inadvertant entry of liquids or excessive contamination into the sample cell. If the lenses within the cell have particles on them, the noise level in the sensor output signal will increase above an acceptable level. The sensor must be returned to the factory for cleaning. It is advisable to keep the sensor sample inlet tube covered with a plastic cover when it is not in use.

1.5 SYSTEM INTERCONNECT DIAGRAM



APPENDIX B

MODEL 1200 AEROSOL SENSOR

1.1 GENERAL INFORMATION

The Model 1200 Aerosol Sensor is an instrument for sensing particles in a gaseous media and developing a data signal to be used by the Model 4100 Particle Counter. It is used typically in ambient air, in manufacturing installations, or in research laboratories.

1.2 PERFORMANCE SPECIFICATIONS

SAMPLE FLOW RATE	0.1 or .01 cubic feet/minute
PARTICLE CONCENTRATION	up to 100,000,000 per cubic foot
PARTICLE SIZE	0.5µm and larger (0.3 µm optional)
SIZING ACCURACY	Stated size, ±5%, based on pulse height measurement.

1.3 DESCRIPTION

The Model 1200 Sensor contains all components necessary to detect the particles and generate the corresponding data signal pulse. It contains the aerosol sampling cell, the light source, the optics, the photomultiplier tube, and an air pump, all of which together generate the data signal. It also contains the calibrate motor and two circuit boards associated with the operation of the photomultiplier tube: a high voltage power supply board and a preamplifier board.

A third dual-function circuit board is contained in the Model 1200. It is the rate generator. The front panel flow switch controls the flow select solenoid, 0.1cfm or .01cfm. The other function is to operate the automatic calibrate solenoid.

1.6 OPERATION

a. Verify that the Model 1200 is connected to the Model 4100 Counter correctly. Make sure that the flexible tubing, if used, is properly connected and that airflow will not be restricted.

b. Turn on the Model 4100 power switch first. Allow the sensor and the counter to temperature stabilize for 5 minutes.

c. Use the switch on the sensor front panel to select the flow rate.

d. Turn on the Model 1200 power switch and allow another 5 minutes for temperature stabilization.

e. After ten minutes has elapsed, the system will automatically calibrate. After calibration the system is in an operational mode.
NOTE: Every ten minutes an automatic calibration will occur for for six seconds.

1.7 FLOW RATE

The flow rates are factory pre-set and the range meter will indicate any change in flow rate by a deviation from the normal scale reading. In the 0.1cfm range, the meter indicates the actual flow rate. In the 0.01cfm range, the meter is only a change-in-flow-rate indicator.

DIGITECH OPERATOR'S MANUAL

for use with Portable Microprocessor Controlled
Multi-Size Range Aerosol Counting System

prepared by
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21 July 86

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Turn on the IBM compatible computer and insert the Digitech disk into drive A. Check the directory. To make the complete system work you will need the following files:

- COM.BAS
- MINE.BAS
- BASIC.COM
- BASRUN.EXE
- DIGI0A.EXE
- DIGI1A.EXE
- DIGI2A.EXE
- DIGI3A.EXE
- DIGI4A.EXE
- DIGINIT.EXE
- DIGITEL.EXE
- MEMO.DOC
- MINE.DOC

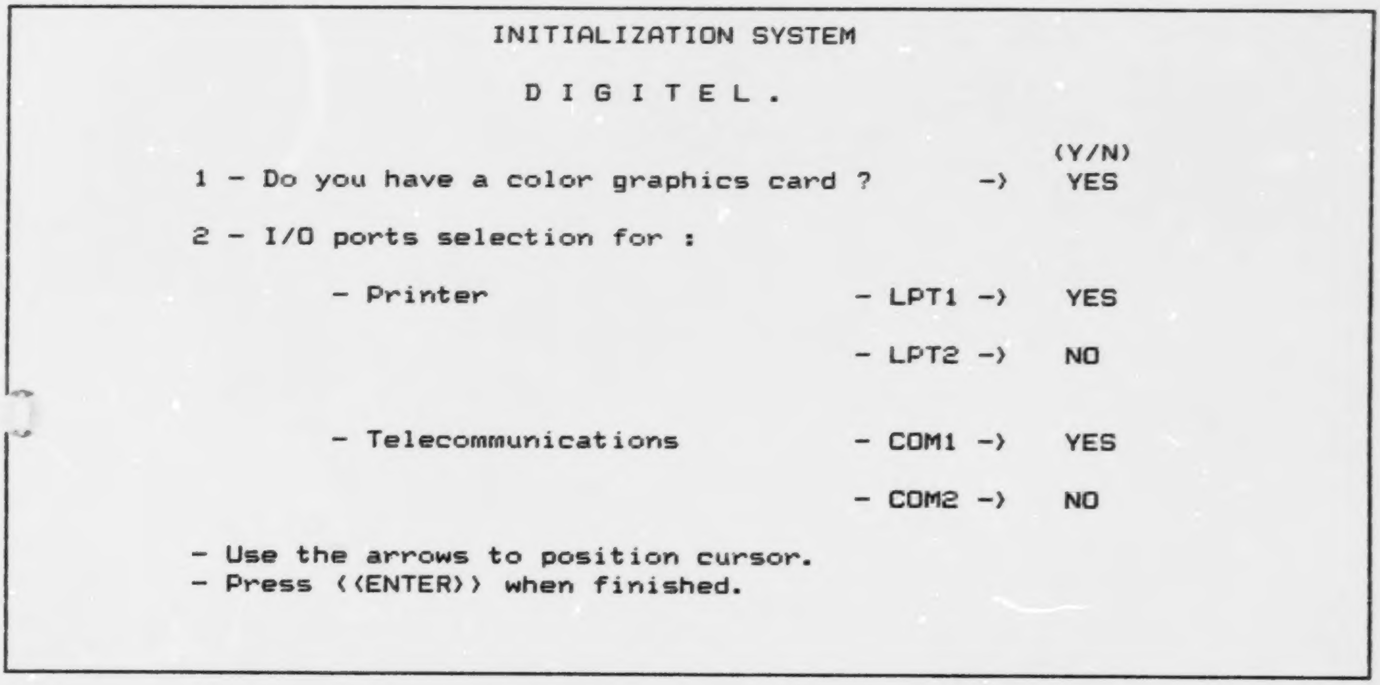
If you have a hard disk system, transfer these files to your hard disk. Also make a back-up copy of the original disk.

INITIAL SET UP

Before using the DIGITEL programs, you must initialize the software to conform to your hardware.

Using the IBM compatible, at the A > , type DIGINIT then press RETURN.

The following screen should appear:



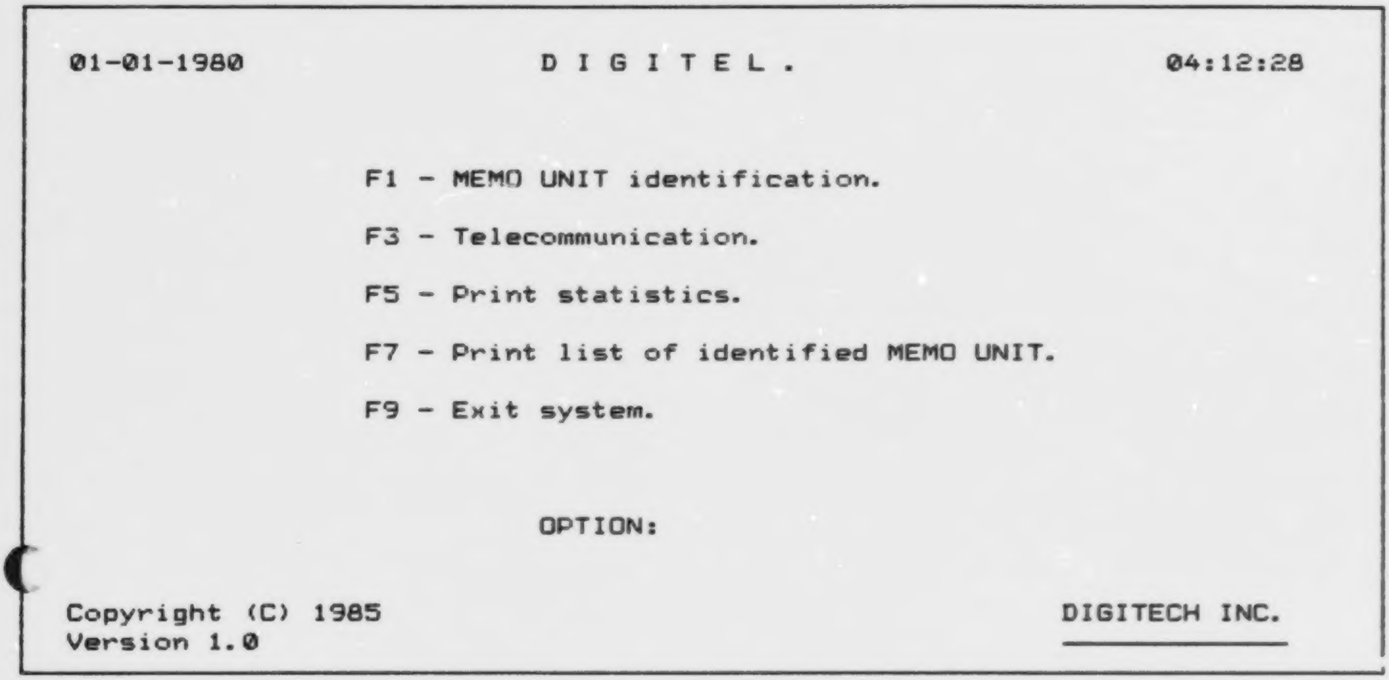
```
                  INITIALIZATION SYSTEM

                   D I G I T E L .

                                                  (Y/N)
1 - Do you have a color graphics card ?      ->    YES

2 - I/O ports selection for :

       - Printer                       - LPT1 ->    YES

                                       - LPT2 ->    NO


       - Telecommunications            - COM1 ->    YES

                                       - COM2 ->    NO

- Use the arrows to position cursor.
- Press <<ENTER>> when finished.
```

Answer the questions according to the hardware that you have installed.

Press ENTER or RETURN to exit the program.

At the A > , type DIGITEL , then press RETURN.

The DIGITEL menu will appear on the screen.



```
01-01-1980                  D I G I T E L .                      04:12:28


                  F1 - MEMO UNIT identification.

                  F3 - Telecommunication.

                  F5 - Print statistics.

                  F7 - Print list of identified MEMO UNIT.

                  F9 - Exit system.


                          OPTION:


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Version 1.0
```
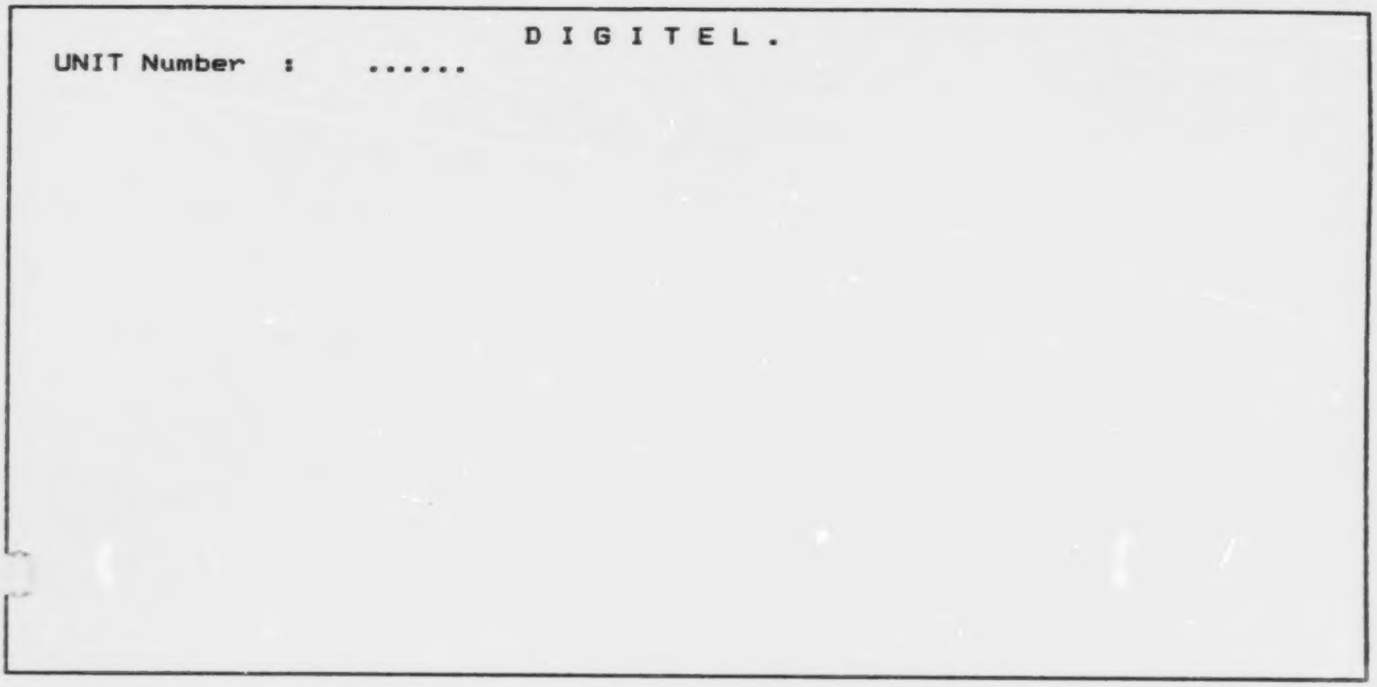

The function keys will be used to select the appropriate action.
The first action required will be to identify the MEMO unit or units that are being used. Each memo unit should have a different number to avoid communication confusion .

Select MEMO unit identification by pressing function key 1 (F1).

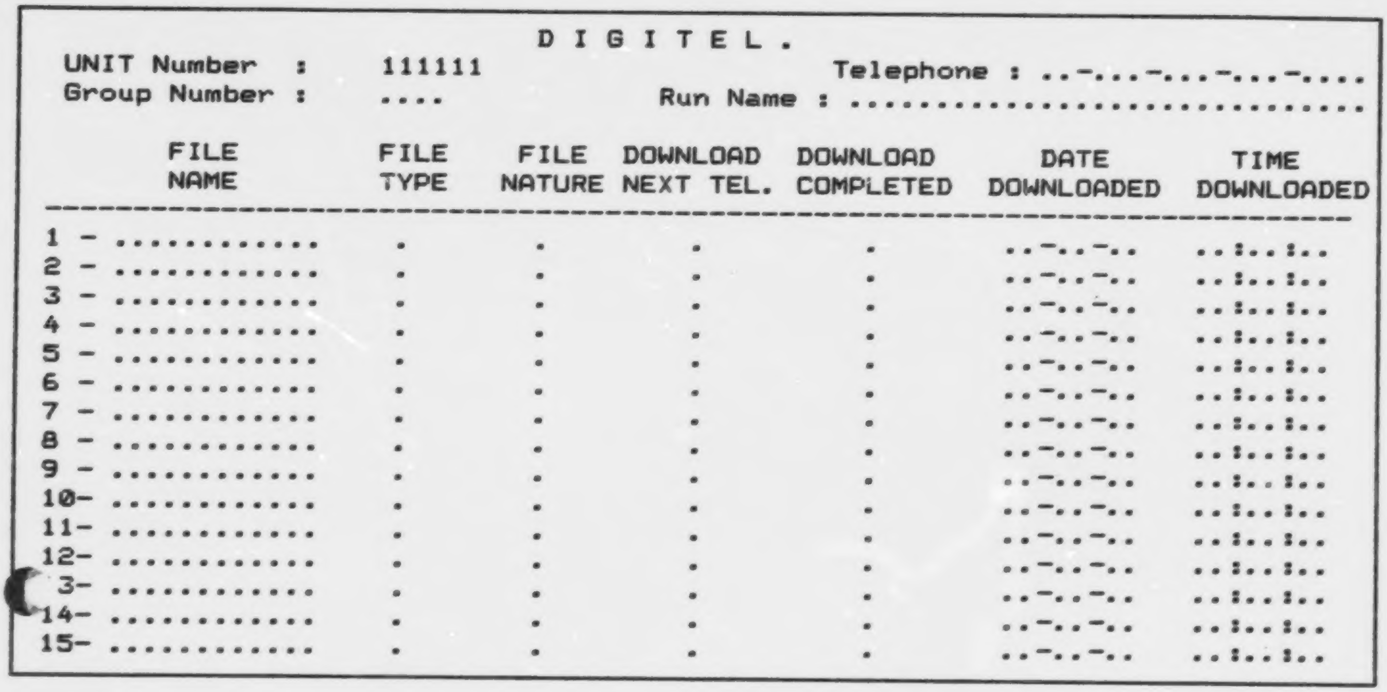
The following screen will appear.



```
                         D I G I T E L .
UNIT Number  :    ......
```

Enter an appropriate 6 digit I.D. number for the first MEMO unit.

The screen information will expand to give the following display.



```
                            D I G I T E L .
 UNIT Number  :     111111                  Telephone : ..-...-...-...-....
 Group Number :     ....            Run Name : ..............................

       FILE          FILE     FILE  DOWNLOAD  DOWNLOAD      DATE          TIME
       NAME          TYPE   NATURE NEXT TEL. COMPLETED  DOWNLOADED    DOWNLOADED
--------------------------------------------------------------------------------
1 - ............      .       .        .         .        ..-..-..      ..:..:..
2 - ............      .       .        .         .        ..-..-..      ..:..:..
3 - ............      .       .        .         .        ..-..-..      ..:..:..
4 - ............      .       .        .         .        ..-..-..      ..:..:..
5 - ............      .       .        .         .        ..-..-..      ..:..:..
6 - ............      .       .        .         .        ..-..-..      ..:..:..
7 - ............      .       .        .         .        ..-..-..      ..:..:..
8 - ............      .       .        .         .        ..-..-..      ..:..:..
9 - ............      .       .        .         .        ..-..-..      ..:..:..
10- ............      .       .        .         .        ..-..-..      ..:..:..
11- ............      .       .        .         .        ..-..-..      ..:..:..
12- ............      .       .        .         .        ..-..-..      ..:..:..
 3- ............      .       .        .         .        ..-..-..      ..:..:..
14- ............      .       .        .         .        ..-..-..      ..:..:..
15- ............      .       .        .         .        ..-..-..      ..:..:..
```

The curser keys may be used to move from field to field on the screen.

If you are not using a modem, do not enter a telephone number.

Use the right curser key to move to the Group number field.

If you do not have multiple groups of MEMO's, there is no need to enter any number in this field.

Use the right curser key to move to the RUN NAME field.

Any 30 character message may be typed into this field.

Enter ENTER or RETURN after typing the desired characters.

The curser will move to line 1 of the file transfer form.

In this section, you will list all the files that you wish to transfer to the MEMO units. The file names are listed in the next screen display in this manual.

Enter the file name including the extension and press RETURN.

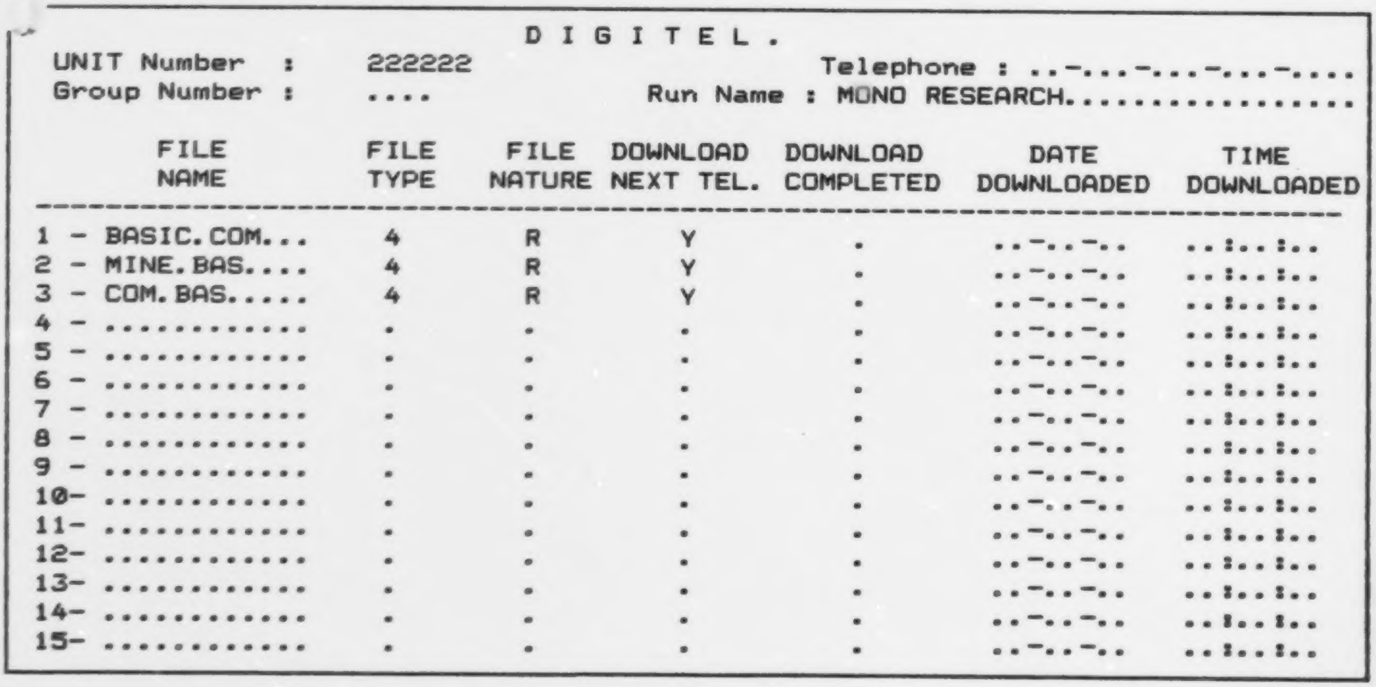
Under FILE TYPE, enter a single digit number.

1 - is not used
2 - operating system - not used since operating system is already in the MENU.
3 - program - directed directly to the program area for immedicate execution.
4 - all other programs or data files.

In this application, only the digit 4 will be used (see example below).
Either an R or a D may be entered into the FILE NATURE.

R - resident file to be down loaded
D - daily - down loaded on a daily auto call system.

All of our files will use R.
Enter a Y for yes under DOWN LOAD on next telecommunication.
Enter the files as shown in the example below.



```
                            D I G I T E L .
 UNIT Number  :     222222                      Telephone : ..-...-...-...-....
 Group Number :     ....                 Run Name : MONO RESEARCH.................

        FILE          FILE    FILE   DOWNLOAD  DOWNLOAD       DATE        TIME
        NAME          TYPE   NATURE NEXT TEL. COMPLETED   DOWNLOADED  DOWNLOADED
-----------------------------------------------------------------------------------
1 - BASIC.COM...       4       R        Y         .        ..-..-..    ..:..:..
2 - MINE.BAS....       4       R        Y         .        ..-..-..    ..:..:..
3 - COM.BAS.....       4       R        Y         .        ..-..-..    ..:..:..
4 - ............       .       .        .         .        ..-..-..    ..:..:..
5 - ............       .       .        .         .        ..-..-..    ..:..:..
6 - ............       .       .        .         .        ..-..-..    ..:..:..
7 - ............       .       .        .         .        ..-..-..    ..:..:..
8 - ............       .       .        .         .        ..-..-..    ..:..:..
9 - ............       .       .        .         .        ..-..-..    ..:..:..
10- ............       .       .        .         .        ..-..-..    ..:..:..
11- ............       .       .        .         .        ..-..-..    ..:..:..
12- ............       .       .        .         .        ..-..-..    ..:..:..
13- ............       .       .        .         .        ..-..-..    ..:..:..
14- ............       .       .        .         .        ..-..-..    ..:..:..
15- ............       .       .        .         .        ..-..-..    ..:..:..
```

When you have entered the file names that you wish to transfer, press F1 to exit back to the menu.

NOTE! To erase a file name place the curser on the beginning of the line and press return.

TRANSFERRING FILES FROM THE IBM COMPATIBLE TO THE MEMO UNIT

Prepare the MEMO to receive the first files from the IBM.

Use the reset "cube" to reset the MEMO. To do this, plug the cube into the 15 pin MEMO III connector for a moment and then unplug it. (You will only do this the first time you use the MEMO.)

The MEMO screen will read:

```
        MEMO III
    ROM VERS.  Rel
          1.5  1.03
    Memory:    256K
```

Press any key to refresh the screen if it goes blank.

Place the MEMO into the RS232/charger.

Connect the power cable and be sure that power is on.

Connect the communications cable between the IBM and the MEMO.

Use the serial port on the IBM that you specified during the initialization.

Connect the end marked MEMO to the RS232/charger.

Press any key to refresh the screen if it goes blank.

Press ENTER and the screen will scroll to read

```
     Route
     Number
```

Enter the 6 digit number that you used to identify the MEMO earlier on the IBM compatible.

Answer Y to confirm your number.

Select the baud rate from the screen by entering the appropriate number.

The baud rate setting chosen must be the same on the MEMO and the IBM compatible.

The baud rate on the IBM will be chosen during the communication set-up.

Choose '4' to set the baud rate to 9600.

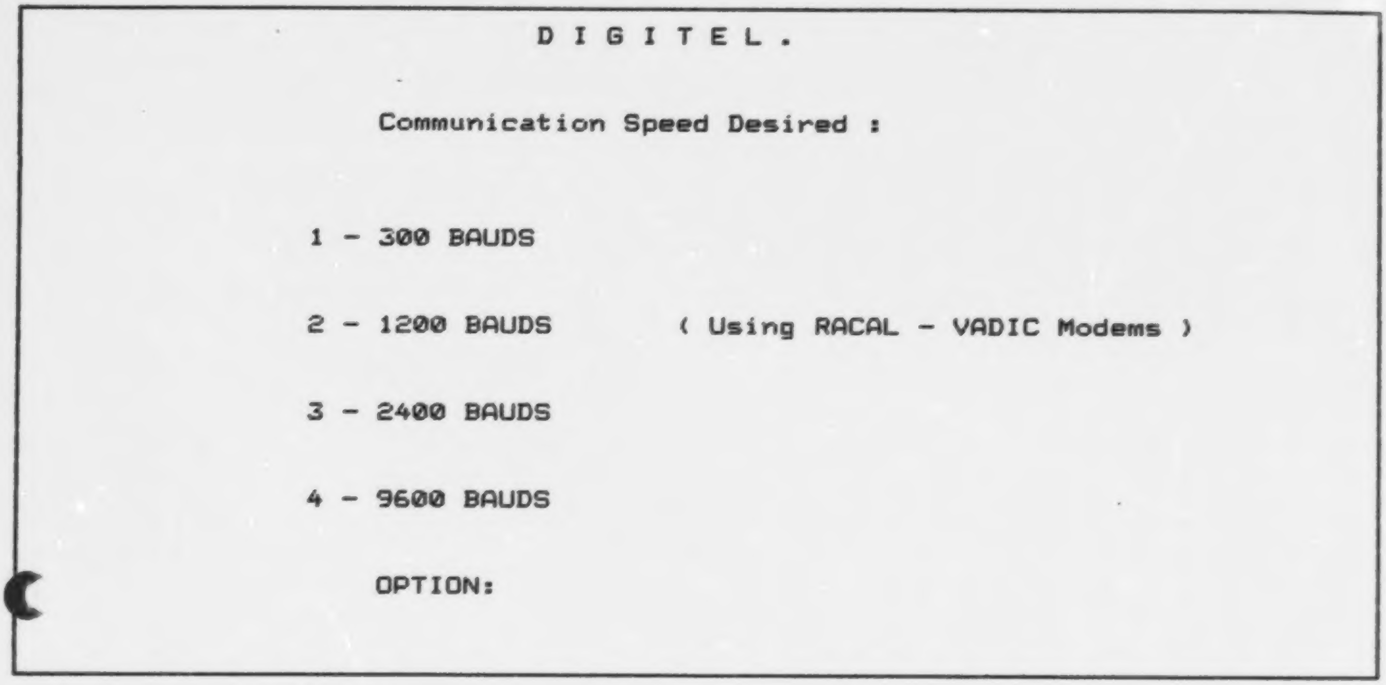
Press Y on the MEMO III to AUTOMATIC CALL and Y to READY TO COMMUNICATE.

The screen on the MEMO should read "WAITING FOR A CALL".

For the moment, leave the MEMO and return to the main computer.

Select F3 on the menu, to set up the communication protocol.

The following screen should be displayed.



```
                    D I G I T E L .

            Communication Speed Desired :


        1 - 300 BAUDS

        2 - 1200 BAUDS        ( Using RACAL - VADIC Modems )

        3 - 2400 BAUDS

        4 - 9600 BAUDS

            OPTION:
```

Select the baud rate to match the baud rate selected on the MEMO.

Select option 4 by typing 4.

The digital communications screen will be displayed.

Press Y to fill the automatic call field.

Enter the MEMO unit Number with the six digit number that you used to identify the MEMO III, and to which you wish to transmit the data.

Type Y for correct number to call on the main computer if all the information entered is correct.

Transmission will begin.

When the transmission is complete, press F1 on the main computer to return to the menu screen.

The MEMO will now display the curser at the A > .

Type DIR then ENTER or RETURN.

All the field names that you transmitted will scroll by on the memo screen.

In addition, a file called IDENTIF will be displayed.

This file was automatically made by the MEMO III.

Pressing F9 on the main computer will exit to the operating system.

Remove the cables that connect the MEMO III to the main computer and remove the power cable. The MEMO III is now ready to be connected to the HIAC/ROYCO system.

PARTICLE COUNT OPERATION

Connect the particle counting system to either the DC power pack or 115 VAC supply If you wish to print out the counter parameters that have been set up on the front panel controls, connect the optional printer, using the print/counter cable supplied with the system. The MEMO III may be connected after the printing is complete. Be sure the low power input cable is connected. DO NOT CONNECT THE COMMUNICATION CABLE UNTIL THE PROGRAM IS LOADED.

NOTE! It is not possible to connect the printer and the MEMO III to the counter at the same time.

All the functions indicated in the HIAC/ROYCO particle counter may be used when setting the front panel controls. However, before activating the MEMO III to begin collecting data, the following setting and operation is mandatory:

a) Special Function 10, computer print out, must be set to yes.
b) The sample mode must be in the time mode.
c) Turn off the delay enable time (time between samples).
d) The stabilization delay (SF03) must be 6 seconds or longer.
e) Number of runs must be off.
f) The remote/local toggle switch must be in remote.
g) If you require the diluter on, set the diluter toggle switch to the desired setting.

Refer to the section in the manual describing the HIAC/ROYCO particle counter system control settings.

Set up the desired counter parameters and try a manual sample run to be sure the settings are so desired.

Use the printer to verify the settings if desired. (NOTE! Special function 10 must be off to use the printer). See Page 12 for typical operating parameters.

When the controls have been set and verified, set the mandatory settings to the required settings and check to see that the MEMO is correctly connected.

OPERATING PARAMETERS

```
SF#01 SYSTEM STATUS
07/22/86    14:08:40

SAMPLE ID = 000000
SAMPLE MODE= TIME
SF#03 STBL DLY= 07S
SAMPLE TIME= 01M 00S
DELAY TIME = 00H 01M
   --- DISABLED
NUMBER OF RUNS= 01
SF#8 ALARM PRINT= NO
SF#9 SHORT PRINT=YES
SF#02 ALARM CHAN= 1
EXT ALARM DISABLED
AUD ALARM DISABLED
CNT > ALARM= 9999999
   --- DISABLED
CNT < ALARM= 0000000
   --- DISABLED
COUNT RATE = 300000
   --- ENABLED
   CH-1      .50UM
   CH-2     1.50UM
   CH-3     2.00UM
   CH-4     3.50UM
   CH-5     5.00UM
   CH-6    10.00UM
SF#05 SAMP VOL=000
```

PREPARING THE MEMO TO RECEIVE DATA

Press any key to activate the MEMO screen if the screen is blank.
At the A > type BASIC MINE.
This will activate the data collection program.
It will take a few seconds for the program to load.
The screen will display the appropriate prompts that must be answered.
Type in the OPERATOR INDENTIFICATION. Any 15 character message may be used. Press ENT to move the curser to the DATE field. The date must be entered numerically, for example 10-28-86 ENT .
In the LOCATION field, any 15 character message may be entered, followed by a RETURN or ENT.
The diluter field will only accept a Y for yes or N for no. If the diluter is being used in the counting system, enter Y and ENT.
The OFF PERIOD field allows the operator to enter the time between samples.
The time must be entered in minutes, from a minimum of 1 to a maximum of 999 minutes. Press ENT after entering the appropriate time. The screen will now display the message:

COMMENT

Type in any 15 character message. Press ENT. The screen will now display:

PRESS THE LETTER S TO START THE PROGRAM

Be sure that all the counter front panel controls are set correctly.
Connect the communication cable at this time.
Press S on the MEMO III.
The message WAITING FOR DATA will be displayed.

The HIAC/ROYCO will begin its cycle. First the air flow pump or pumps will start for the specified delay time entered from the counter front panel. After the delay, the counter will begin to count.

When the count is completed, the data will be sent to the MEMO III. The MEMO screen will display the numbers from 1 to 15, as it is receiving the 15 fields of data. As soon as the data is received the timer in the MEMO will begin to time the time between samples. After the preset time has been reached the counter is activated and the cycle will be repeated.

Do not interrupt the counter or the MEMO during a count or data transfer operation. All the data that you have collected may be lost. The best time to exit the cycle is immediately after a data transfer has taken place. The 'PAUSE' message will be displayed at that time.
Press the FCT key on the MEMO and the message will be displayed:
"Do you wish to exit now?"
Press Y to exit or N if you wish the timing to continue.
Loss of power or interruption of the data transfer will cause irreversable damage to the data file and all data collected will be lost.
If the program is restarted, the old data will be erased , however the operator is given the option of down loading the data to the IBM if the file is undamaged. If the data collected previously is still in the MEMO it will be erased if Y is entered to the prompt
"OK to erase data from [date]"
Answering no will allow the operator to up load to the IBM before erasing the data.

TRANSFERRING DATA FROM THE MEMO TO THE IBM COMPATIBLE

Connect the communications cable between the MEMO and the IBM compatible computer. Also connect the power cord to the MEMO and be sure that power is on.

At the A> on the MEMO type BASIC COM , then press ENT . This will run the communications program.

The screen on the MEMO will be

```
           .
ON 1 of 0

FCT-C = COM
FCT-D - DELET
```

The first line is blank except for a . and the second line shows first the program number in the file list, while the second number shows the number of files that are in the transfer list.

Type in the name of the file that you wish to send to the IBM compatible.

The file name that you type must be entered in two steps.

To enter the file name MINE.DAT , enter MINE then press return, and the curser will automatically move to the right of the period. Now type in DAT and press ENT.

NOTE! You do not type in a period.

The second line now reads, on 2 of 1, and the first line will be blank.

Press the FCT key and the C to communicate or press FCT and then D to delete the file name from the list. If you press FCT-C , the screen will display the baud rate selection table.

Select 4 for 9600 baud. This selection must also match the baud rate setting that you select on the IBM compatible.

Leave the MEMO unit for the moment and load the DIGITEL program by typing 'DIGITEL' and pressing ENT.

The familiar DIGITEL main menu will be displayed on the screen.

Select option 1 using the F1 function key.

Type in the MEMO identification number matching the MEMO that you wish to work with. The table will show the names of files that would be transmitted from the IBM to the MEMO. But since we do not wish to transmit from the IBM to the MEMO at this time, blank out any file names. To do this, use the curser keys (not the ENT key). When the curser falls on the file name, press ENT to delete the name.

When the file names are deleted, press F1 to return to the main menu.

Then select F3 for the communication program.

Select the baud rate to match the MEMO baud rate.

Press 4.

At the prompt, enter Y to AUTOMATIC CALL.

Enter the 6 digit identification number.

GO BACK TO THE MEMO, type any key if the screen is blank and enter a Y to AUTOMATIC CALL and a Y to READY TO COMMUNICATE.

Press Y to confirm your I.D. on the IBM compatible and communications will start. When the communication is complete, press F1 on the IBM compatible to return to the main menu.

NOTE! You transmitted the file called MINE.DAT which has the data that you collect from the HIAC/ROYCO counter. When the file is placed into the IBM compatible, the name is changed to MINE.111 if the last 3 digits of the MEMO were 111 or MINE.222 if the last 3 digits of the MEMO were 222. This is done so that the file MINE.DAT could be uploaded from more than 1 MEMO, without overwriting in the IBM and also to identify which MEMO the file came from.

When communication is completed, press F1 to return to main menu and press F9 to exit.

COMMUNICATIONS FROM IBM TO MEMO (other than the first time)

The first time that transmission takes place between the IBM compatible and a MEMO, it is necessary to assign an identification number to the MEMO. This number is maintained by the MEMO and subsequent transmissions are simplified.

Prepare the MEMO by selecting the BASIC.COM program as indicated earlier. Delete any files you do not wish to transmit to the IBM compatible. Select the baud rate and by answering Y bring up the WAITING FOR A CALL prompt.

At the IBM compatible computer prepare the transmitting form by entering the name of the file into the form just as you did the very first time you communicated from the IBM to the MEMO.

Enter the communications program with F3 and follow the prompts.

If the MEMO III has been reset using the reset "cube" and you wish to return to the CPM operating system, the following sequence will perform the necessary functions.

1. Enter the identification number of the unit.
2. Enter Y to confirm the number
3. When the prompt reads "Automatic Call", press the FCT key.

The A prompt will appear.

When the A prompt is present the MEMO is at the system level and most normal CPM commands such as DIR, ERA, etc will apply

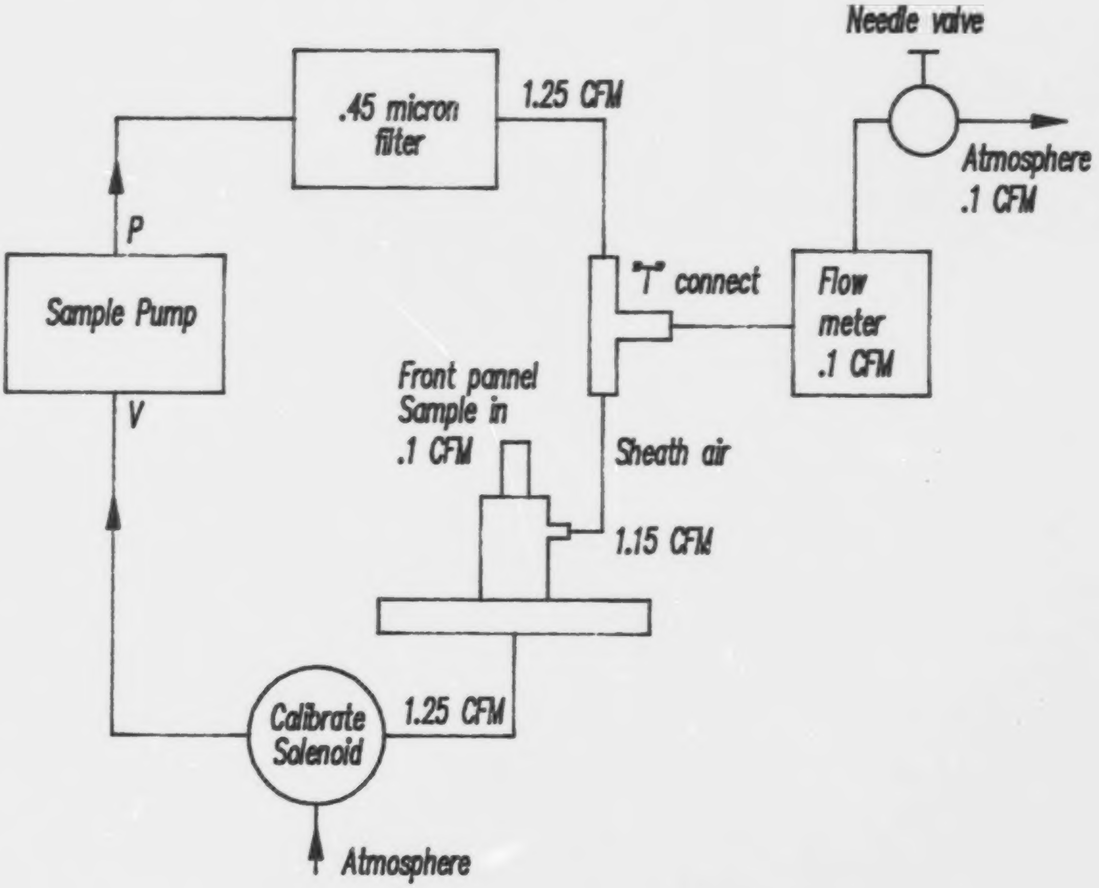
RESET BLOCK

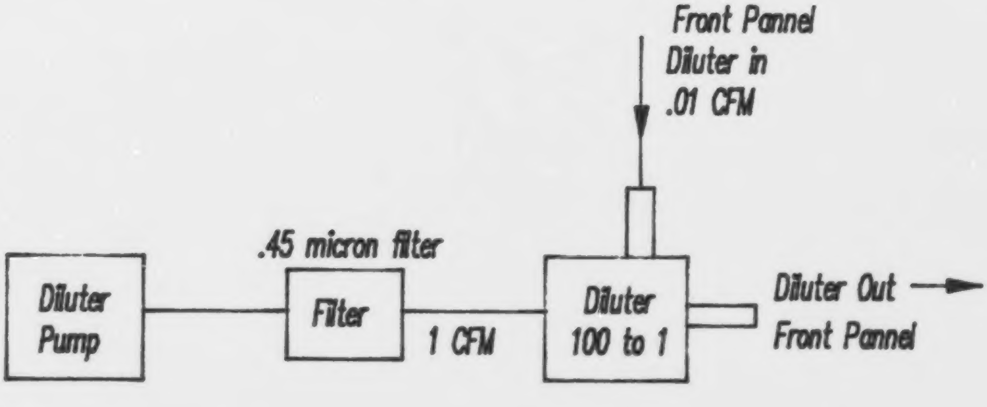
The Digitech computer does not have an "on" - "off" switch and must therefore have some means of resetting the system in the event that the system should "lock-up". In addition to resetting the system, it is also possible to use the reset block to return the power save mode to its default setting. In this mode, the screen will go blank after approximately 10 seconds if a keyboard key is not pressed. The power save mode should be invoked if the computer will not be plugged in for periods greater than 24 hours.

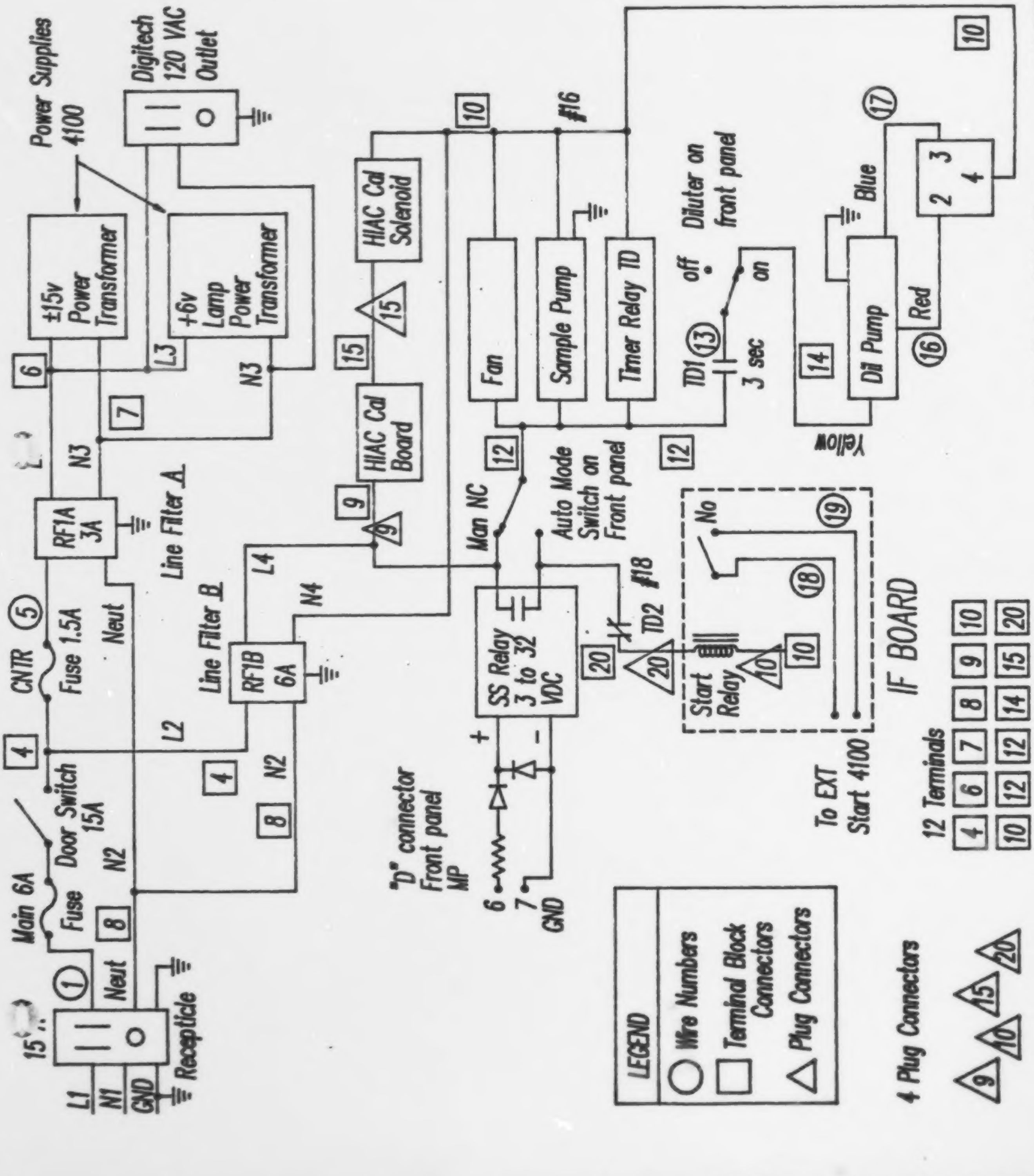
To reset the system simply remove the Digitech from the charger/RS232 holder and mementarily plug the block into the computers.

A few seconds after the block is removed, the screen will go blank and stay blank unit a key is pressed.

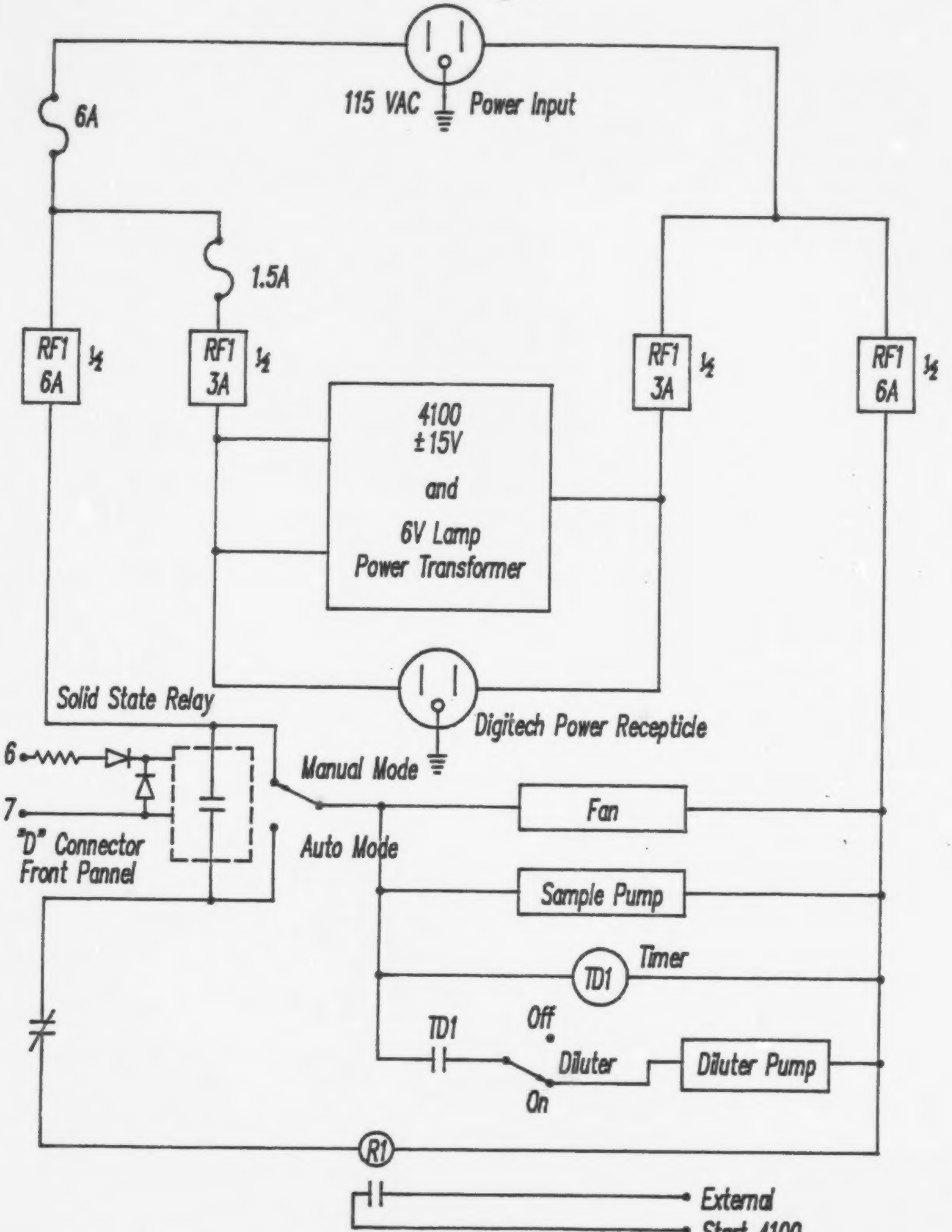
AIR FLOW SYSTEM





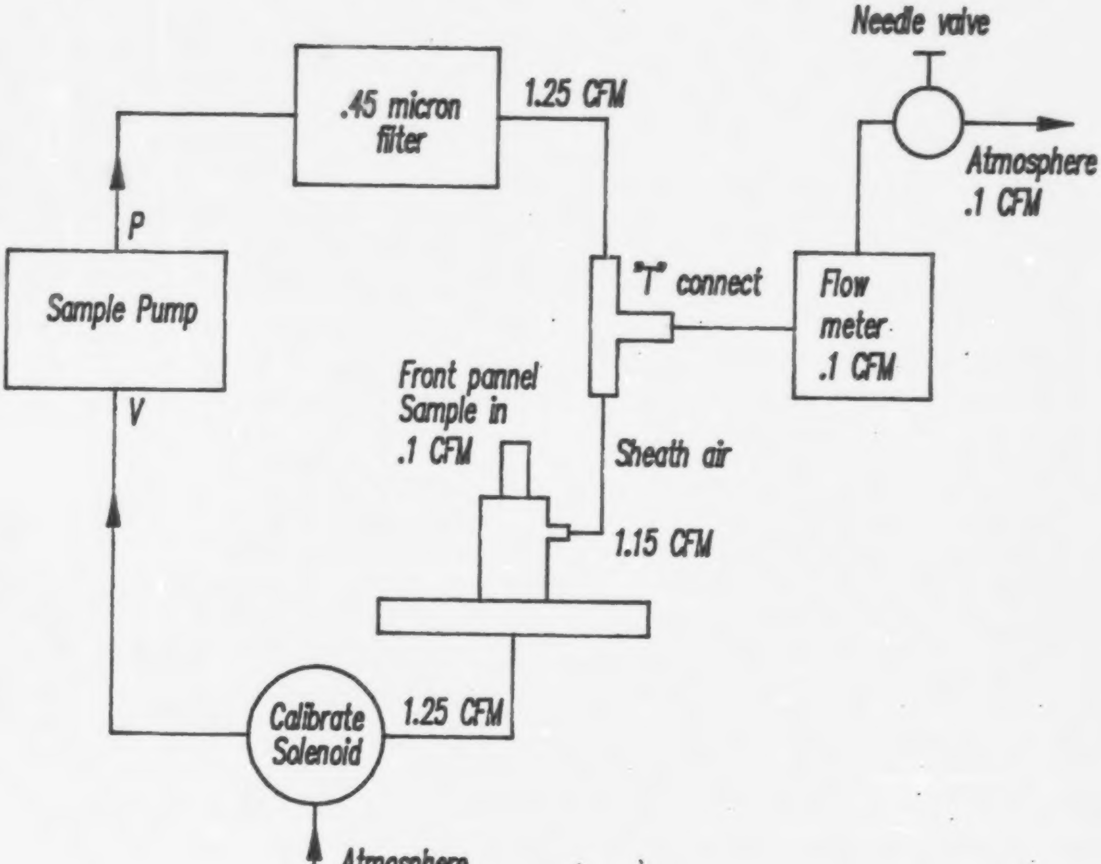


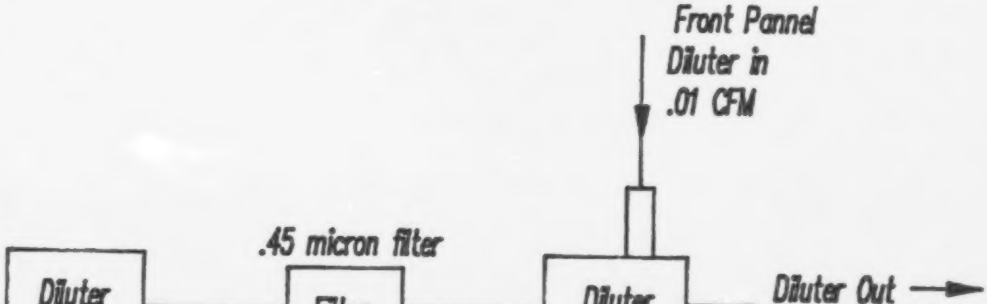
Auto Start – Wiring Diagram



AUTO START SCHEMATIC

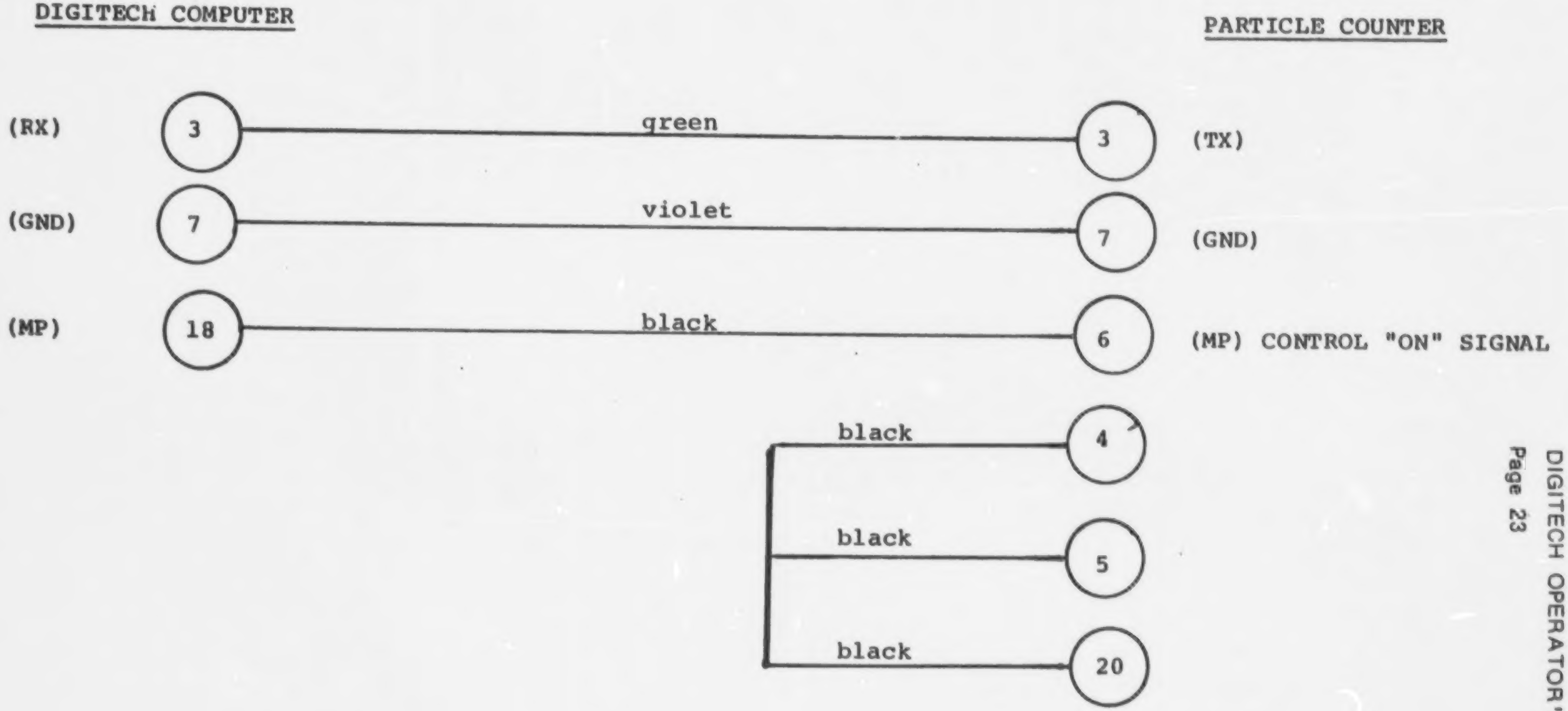
AIR FLOW SYSTEM





TITLE: BON CABLE FROM HAND-HELD DIGITECH COMPU R
"MR1" PARTICLE COUNTER

MONO RESEARCH LABORATOR LTD.
Box 566, #300 Hwy 7 W.
Brampton, Ontario L6V 2L6
416-454-4000



PINS,IN MALE "D" CONNECTOR-----------Ribbon Cable-----------PINS,IN MALE "D" CONNECTOR

July 22 1986

PD

```
EAMONN         7-21-86 LAB2           Y20 TEST12         MONO RESX00:00:1507BPOP
RPGPLP000129100001470000097000004400000200000002X00:01:0007BPOPSPRPGPLP0000039
00000030000000000000000000010000000X00:01:0007BPOPSPRPGPLP0000053000000100000000
00000000000000000000X00:01:0007BPOPSPRPGPLP0000031000000000000000000000000000000
00000X00:01:0007BPOPSPRPGPLP000003500000010000001000000100000000000000X00:01:000
7BPOPSPRPGPLP000003000000050000003000000200000010000000X00:01:0007BPOPSPRPGPLP00
0003500000010000001000000000000000000000X00:01:0007BPOPSPRPGPLP00000270000001000
0000000000000000000000000X00:01:0007BPOPSPRPGPLP00000280000003000000100000000000
0000000000X00:01:0007BPOPSPRPGPLP000003300000040000000000000000000000000000X00:0
1:0007BPOPSPRPGPLP000001700000010000001000000000000000000000X00:01:0007BPOPSPRPG
PLP000002600000070000004000000200000010000000X00:01:0007BPOPSPRPGPLP000002500000
040000003000000300000010000000X00:01:0007BPOPSPRPGPLP000002000000020000000000000
000000000000000X00:01:0007BPOPSPRPGPLP000002300000010000000000000000000000000000
X00:01:0007BPOPSPRPGPLP000001400000010000000000000000000000000000X00:01:0007BPOP
SPRPGPLP000002000000010000001000000100000000000000X00:01:0007BPOPSPRPGPLP0000017
00000040000003000000100000010000000X00:01:0007BPOPSPRPGPLP0000024000000000000000
00000000000000000000X00:01:0007BPOPSPRPGPLP0000018000000100000010000001000000000
00000X00:01:0007BPOPSPRPGPLP000002100000020000002000000000000000000000X00:01:000
7BPOPSPRPGPLP000001600000020000000000000000000000000000X00:01:0007BPOPSPRPGPLP00
0003300000090000009000000500000030000000X00:01:0007BPOPSPRPGPLP00000240000001000
0000000000000000000000000X00:01:0007BPOPSPRPGPLP00000240000002000000100000000000
0000000000X00:01:0007BPOPSPRPGPLP000000400000000000000000000000000000000000X00:0
1:0007BPOPSPRPGPLP000002100000010000000000000000000000000000X00:01:0007BPOPSPRPG
PLP000001300000010000000000000000000000000000X00:01:0007BPOPSPRPGPLP000002100000
060000003000000200000000000000X00:01:0007BPOPSPRPGPLP000002400000010000000000000
000000000000000X00:01:0007BPOPSPRPGPLP000001800000000000000000000000000000000000
0:01:0007BPOPSPRPGPLP000002000000030000000000000000000000000000X00:01:0007BPOP
SPRPGPLP000002100000060000004000000200000020000001X00:01:0007BPOPSPRPGPLP0000022
00000010000001000000000000000000000X00:01:0007BPOPSPRPGPLP0000019000000100000000
00000000000000000000X00:01:0007BPOPSPRPGPLP0000010000000200000020000001000000100
00000X00:01:0007BPOPSPRPGPLP000001300000020000000000000000000000000000X00:01:000
7BPOPSPRPGPLP000002000000020000002000000100000010000000X00:01:0007BPOPSPRPGPLP00
0001300000040000000000000000000000000000X00:01:0007BPOPSPRPGPLP00000120000004000
0003000000300000020000000X00:01:0007BPOPSPRPGPLP00000180000000000000000000000000
0000000000X00:01:0007BPOPSPRPGPLP000001300000000000000000000000000000000000X00:0
1:0007BPOPSPRPGPLP000001500000010000000000000000000000000000X00:01:0007BPOPSPRPG
PLP000001200000000000000000000000000000000000X00:01:0007BPOPSPRPGPLP000000900000
000000000000000000000000000000X00:01:0007BPOPSPRPGPLP000002100000060000004000000
200000010000000X00:01:0007BPOPSPRPGPLP000001000000010000001000000100000000000000
X00:01:0007BPOPSPRPGPLP000001500000010000001000000100000010000000X00:01:0007BPOP
SPRPGPLP000001400000000000000000000000000000000000X00:01:0007BPOPSPRPGPLP0000034
00000060000003000000200000000000000X00:01:0007BPOPSPRPGPLP0000049000001600000080
00000300000020000000X00:01:0007BPOPSPRPGPLP0000034000000700000050000003000000100
00001X00:01:0007BPOPSPRPGPLP000003400000050000003000000100000010000000X00:01:000
7BPOPSPRPGPLP000003400000060000001000000000000000000000X00:01:0007BPOPSPRPGPLP00
0003900000060000000000000000000000000000X00:01:0007BPOPSPRPGPLP00000530000012000
0003000000100000010000000X00:01:0007BPOPSPRPGPLP00000500000007000000200000000000
0000000000X00:01:0007BPOPSPRPGPLP000004600000060000001000000000000000000000X00:0
1:0007BPOPSPRPGPLP000003100000030000002000000100000000000000X00:01:0007BPOPSPRPG
PLP000003900000060000002000000000000000000000X00:01:0007BPOPSPRPGPLP000013100000
410000011000000400000000000000X00:01:0007BPOPSPRPGPLP000004100000030000001000000
000010000000
```

SAMPLE DATA FROM IBM

PROGRAM LISTING
MINE.BAS

```
5 ' DATE OF LAST REVISION        July 17, 1986
10 CLS$ = CHR$(26) : BELL$ = CHR$(7) + CHR$(7) : DOS = 8 : ESC$ = CHR$(27)
30 OPTION BASE 0 : ' MAKE THE LOWEST CELL IN ARRAY TO BE ZERO
33 WIDTH 255 ' NEEDED TO STOP BASIC FROM INSERTING CARRIAGE RETURNS
36 POKE 77,255 ' CTRL-C DISABLED
38 POKE 80,0  ' SECONDS TO POWER SAVE MODE ( 0 = NO POWER SAVE )
40 DEF FNBCD(X) = (PEEK(X) / 16 * 10) + (PEEK(X) AND 15)
45 ' THE ABOVE LINE IS A FUNCTION THAT CONVERTS BINARY CODED DECIMAL
46 ' TO NORMAL DECIMAL
50 GOTO 1000
59 ' ********      POSITIONING THE CURSUR    *******START
60 ' *   THE VARIABLES ARE                                   *
70 ' *         -- ROWPOS = COLUMN POSITION                   *
80 ' *         -- COLPOS = ROW POSITION                      *
90 ' *****************************************************
100 PRINT CHR$(27);"=";CHR$(ROWPOS+31);CHR$(COLPOS+31);
110 RETURN
120 ' ********      POSITIONING THE CURSUR    *********END
130 '
140 ' ********         ENTERING A FIELD        *******START
150 ' *   THE VARIABLES ARE                                  *
160 ' *         -- ROWPOS  = COLUMN TO START FIELD IN        *
170 ' *         -- COLPOS  = ROW TO SRART FIELD IN           *
180 ' *         -- FLEN    = FIELD LENGTH                    *
190 ' *         -- TABLE$  = TABLES OF CHARS TO ACCEPT       *
200 ' *         -- FCT$    = FUNTION KEYS TO ACCEPT          *
210 ' *         -- SPECIAL = SET OF SPEC CHARS TO ACCEPT     *
220 ' ****************************************************
250 GOSUB 100
260 ANSWER$ = ""
270 ENTER$ = ""
280 INST$ = INKEY$
290 IF INST$ = "" THEN 280
300 IF INST$ = CHR$(27) THEN 680
310 IF INST$ = CHR$(13) THEN 730
320 IF INST$ = CHR$(8) THEN 620
330 IF LEN(ANSWER$) = FLEN THEN 590 : ' ** ERROR TRAP **
340 EROR$ = "Y"
350 FOR TABCOUNT = 1 TO LEN(TABLE$)
360 ON VAL(MID$(TABLE$,TABCOUNT,1)) GOSUB 480,510
370 NEXT TABCOUNT
380 IF LEN(SPECIAL$) ) 0 THEN GOSUB 560
390 IF EROR$ = "Y" THEN 590 : ' ** ERROR TRAP **
400 ANSWER$ = ANSWER$ + INST$
410 ' NEXT 2 LINES USED TO BLANK FIELD AFTER ONE KEY STROKE
420 IF ENTER$ = "" THEN PRINT SPC(FLEN):GOSUB 100
430 ENTER$ = "BLANKED"
440 PRINT INST$ ;
450 IF LEN(ANSWER$) = FLEN THEN PRINT CHR$(8);
460 GOTO 280
470 ' ******************  TABLE # 1  NUMBERS ONLY ****
480 IF ASC(INST$) ) 47 AND ASC(INST$) ( 58 THEN EROR$ = "N"
490 RETURN
500 ' ******************  TABLE # 2  ALHABET ONLY ****
510 IF INST$ = " " THEN EROR$ = "N"
```

```
520 IF ASC(INST$) >64 AND ASC(INST$) < 91 THEN ERORS = "N"
530 IF ASC(INST$) >96 AND ASC(INST$) < 123 THEN ERORS = "N"
540 RETURN
550 ' ************************** SPECIAL CHARACTERS ****
560 IF INSTR(SPECIAL$,INST$) > 0 THEN ERORS = "N"
570 RETURN
580 ' ********************************** ERROR TRAP ****
590 PRINT BELL$;
600 GOTO 280
610 ' ******************************* BACKSPACE KEY ****
620 IF LEN(ANSWER$) = 0 THEN 590 : ' *** ERROR TRAP ***
630 IF LEN(ANSWER$) <> FLEN THEN PRINT CHR$(8);
640 ANSWER$ = LEFT$(ANSWER$,LEN(ANSWER$)-1)
650 PRINT " ";CHR$(8);
660 GOTO 280
670 ' ********************************  FCT ROUTINE ****
680 IF LEN(FCT$) = 0 THEN 590 : ' *** ERROR TRAP ***
690 FCTKEY$ = INKEY$
700 IF FCTKEY$ = "" THEN 690
710 IF INSTR(FCT$,FCTKEY$) = 0 THEN 590
720 LET ANSWER$ = CHR$(27) + FCTKEY$
730 RETURN
740 ' ********        ENTERING A FIELD        *********END
800 ' ********        DOS SUBROUTINE          *******START
810 CALL DOS ( FIRST% , SECOND% , THIRD% )
820 RETURN
830 ' ******        DOS SUBROUTINE            *********END
900 ' ******     WAIT FOR ENT KEY ROUTINE     *********
910 IF INKEY$ <> CHR$(13) THEN 910
920 RETURN
950 '*******            Y/N REPLY             *********
960 ROWPOS=4 : COLPOS=14 : FLEN=1 : TABLE$="" : FCT$="" : SPECIAL$="YN"
970 GOSUB 250
980 IF ANSWER$ = "" THEN 970
990 RETURN
1000 ' --------------- ENTER HEADER DATA --------------
1010 PRINT CLS$;
1020 PRINT "Operator:"
1030 PRINT
1040 PRINT "Date:"
1050 ' --------------- OPERATOR ------------------------
1060 ROWPOS=2 : COLPOS=1 : FLEN=15 : TABLE$="12" : FCT$="X" : SPECIAL$=".-"
1070 GOSUB 250
1080 IF ANSWER$ = ESC$ + "X" THEN 9000 ' EXIT
1090 IF ANSWER$ = "" THEN 1110
1100 OP$ = ANSWER$
1110 ' ------------------ DATE --------------------------
1120 ROWPOS=4 : COLPOS=1 : FLEN=8 : TABLE$="1" : FCT$="X" : SPECIAL$="-"
1130 GOSUB 250
1140 IF ANSWER$ = ESC$ + "X" THEN 9000 ' EXIT
1150 IF ANSWER$ = "" THEN 1180
1160 DATE$ = ANSWER$
1170 ' --------------- NEXT SCREEN -----------------
1180 PRINT CLS$;
1190 PRINT "Location:"
```

```
1200 PRINT
1210 PRINT "Diluter:"
1220 ' -------------- LOCATION ----------------------
1230 ROWPOS=2 : COLPOS=1 : FLEN=15 : TABLE$="12" : FCT$="X" : SPECIAL$=".-"
1240 GOSUB 250
1250 IF ANSWER$ = ESC$ + "X" THEN 9000 ' EXIT
1260 IF ANSWER$ = "" THEN 1290
1270 LOCAT$ = ANSWER$
1280 ' -------------- DILUTER -----------------------
1290 ROWPOS=4 : COLPOS=1 : FLEN=1 : TABLE$="" : FCT$="X" : SPECIAL$="YN"
1300 GOSUB 250
1310 IF ANSWER$ = ESC$ + "X" THEN 9000 ' EXIT
1320 IF ANSWER$ = "" THEN 1350
1330 DIL$ = ANSWER$
1340 ' -------------- NEXT SCREEN ----------------
1350 PRINT CLS$;
1360 PRINT "Off period:"
1370 PRINT
1380 PRINT "Comment:"
1390 ' ------------- OFF PERIOD ---------------------
1400 ROWPOS=2 : COLPOS=1 : FLEN=3 : TABLE$="1" : FCT$="X" : SPECIAL$=""
1410 GOSUB 250
1420 IF ANSWER$ = ESC$ + "X" THEN 9000 ' EXIT
1430 IF ANSWER$ = "" THEN 1460
1440 OFP$ = ANSWER$
1450 ' -------------- COMMENT ---------------------
1460 ROWPOS=4 : COLPOS=1 : FLEN=15 : TABLE$="12" : FCT$="X" : SPECIAL$=".-"
1470 GOSUB 250
1480 IF ANSWER$ = ESC$ + "X" THEN 9000 ' EXIT
1490 IF ANSWER$ = "" THEN 1510
1500 COM$ = ANSWER$
1510 PRINT CLS$;
1520 PRINT "   Press the"
1530 PRINT " letter ";CHR$(34);"S";CHR$(34);" to"
1540 PRINT "   start the"
1550 PRINT "    program";
1560 DUMMY$ = INKEY$
1565 IF DUMMY$ = "" THEN 1560
1570 IF DUMMY$ = ESC$ THEN 9000 ' EXIT
1580 IF DUMMY$ <> "S" THEN PRINT BELL$: : GOTO 1560
1590 ' ------------ SET UP DATA FILE ---------
1600 DIM IN$(15) ' READ DATA INTO AN ARRAY
1605 OPEN "R",#1,"MINE.DAT",65
1610 FIELD #1,15 AS BOP$,8 AS BDATE$,15 AS BLOCAT$,1 AS BDIL$,3 AS BOFP$,15
 AS BCOM$,8 AS BCHECK$
1620 FIELD #1,1 AS BID$,8 AS BET$,2 AS BSD$,2 AS BB$,2 AS BO$,2 AS BST$,2 A
S BAR$,2 AS BA1$,2 AS BA2$,7 AS BC1$,7 AS BC2$,7 AS BC3$,7 AS BC4$,7 AS BC5
$,7 AS BC6$
1630 GET #1,1
1640 IF BCHECK$ <> "MONO RES" THEN 1800 ' NEW FILE MADE
1650 PRINT CLS$;BELL$;
1660 PRINT "OK to erase"
1670 PRINT "data from"
1680 PRINT BDATE$;".";
1690 GOSUB 960
```

```
1700 IF ANSWER$ = "N" THEN 9000 ' EXIT
1710 CLOSE
1720 KILL "MINE.DAT"
1730 GOTO 1605
1800 ' ------ WRITE HEADER RECORD -----------
1810 LSET BOP$ = OP$
1820 LSET BDATE$ = DATE$
1830 LSET BLOCAT$ = LOCAT$
1840 LSET BDIL$ = DIL$
1850 LSET BOFP$ = OFP$
1860 LSET BCOM$ = COM$
1870 LSET BCHECK$ = "MONO RES"
1880 PUT #1,1
1900 ' ---------- START COLLECTING DATA --------
1902 PRINT CLS$;
1904 PRINT "Waiting for"
1906 PRINT "data"
1915 GOSUB 5210 ' ENABLE RS232 AT BAUD 9600
1920 GOSUB 5010 ' MP LINE HIGH
1930 GOSUB 5410 ' WAIT FOR A CHAR IN THE BUFFER AND THEN READ ALL
1940 GOSUB 5110 ' MP LINE LOW
1950 GOSUB 5310 ' RS232 OFF
1960 LSET BID$ = IN$(1)
1970 LSET BET$ = IN$(2)
1980 LSET BSD$ = IN$(3)
1990 LSET BB$  = IN$(4)
2000 LSET BO$  = IN$(5)
2010 LSET BST$ = IN$(6)
2020 LSET BAR$ = IN$(7)
2030 LSET BA1$ = IN$(8)
2040 LSET BA2$ = IN$(9)
2050 LSET BC1$ = IN$(10)
2060 LSET BC2$ = IN$(11)
2070 LSET BC3$ = IN$(12)
2080 LSET BC4$ = IN$(13)
2090 LSET BC5$ = IN$(14)
2100 LSET BC6$ = IN$(15)
2110 PUT #1 ' NO RECORD NUMBER MEANS GO TO THE NEXT RECORD. i.e. +1
2120 GOSUB 4900 ' SET SYSTEM CLOCK TO ZERO
2130 PRINT CLS$;
2140 PRINT "Pause"
2150 MIN = 0
2160 DUMMY$ = ""
2170 WHILE (MIN < VAL(OFP$) AND DUMMY$ <> ESC$)
2180     FIRST% = 82 : SECOND% = 0 : THIRD% = 0
2190     GOSUB 810 ' READ CLOCK
2200     MIN = FNBCD(73)*60 + FNBCD(74) ' READ HOURS(73) AND MIN(74)
2210     DUMMY$ = INKEY$
2220 WEND
2230 IF DUMMY$ = ESC$ THEN 7000 ' EXIT
2240 GOTO 1902
4900 ' ------ CLOCK TO ZERO
4910 POKE 69,0 : POKE 70,0 : POKE 71,0 : POKE 72,0
4920 POKE 73,0 : POKE 74,0 : POKE 75,0
4930 FIRST% = 81 : SECOND% = 0 : THIRD% = 0
```

```
4940 GOSUB 810
4950 RETURN
5000 ' ---------------------------------------- MP LINE HIGH
5010 OUT 3,12 ' MP LINE HIGH
5020 RETURN
5100 '----------------------------------------- MP LINE LOW
5110 OUT 3,13 ' MP LINE LOW
5120 RETURN
5200 '--------------------------- TURN RS232 ON - 1200 BAUD
5210 FIRST% = 70 : SECOND% = 1 : THIRD% = 0
5220 GOSUB 810
5230 FIRST% = 90 : SECOND% = 0 : THIRD% = 0
5240 GOSUB 810
5250 RETURN
5300 '---------------------------------------- TURN OFF RS232
5310 FIRST% = 91 : SECOND% = 0 : THIRD% = 0
5320 GOSUB 810
5330 RETURN
5400 ' ------------- RECEIVE ONE SET OF DATA ----------
5410 FIRST% = 67 : SECOND% = 0 : THIRD% = 0
5420 GOSUB 810 ' TEST FOR A CHARACTER IN THE BUFFER
5430 TEST3 = THIRD% AND 15
5440 IF TEST3 = 0 THEN 5420 ' WAIT FOR A CHARACTER
5450 COUNT = 0 ' READ THE "!SF10" INTO CELL 0
5460 INLENGTH = 5 ' READ !SF10
5470 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5480 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5490 INLENGTH = 1 ' READ STATION ID
5500 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5510 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5520 INLENGTH = 8 ' READ ELAPSED TIME
5530 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5540 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5550 INLENGTH = 2 ' READ STABILIZATION DELAY
5560 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5570 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5580 INLENGTH = 2 ' READ BASELINE
5590 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5600 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5610 INLENGTH = 2 ' READ OVERCONCENTRATION
5620 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5630 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5640 INLENGTH = 2 ' READ SELF TEST
5650 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5660 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5670 INLENGTH = 2 ' READ ALARM RATE
5680 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5690 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5700 INLENGTH = 2 ' READ ALARM >
5710 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5720 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5730 INLENGTH = 2 ' READ ALARM <
5740 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5750 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5760 INLENGTH = 7 ' READ CHANNEL 1
```

```
5770 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5780 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5790 INLENGTH = 7 ' READ CHANNEL 2
5800 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5810 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5820 INLENGTH = 7 ' READ CHANNEL 3
5830 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5840 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5850 INLENGTH = 7 ' READ CHANNEL 4
5860 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5870 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5880 INLENGTH = 7 ' READ CHANNEL 5
5890 COMMA$ = "Y" ' WILL THERE BE A COMMA AFTER THIS FIELD
5900 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5910 INLENGTH = 7 ' READ CHANNEL 6
5920 COMMA$ = "N" ' WILL THERE NOT BE A COMMA AFTER THIS FIELD
5930 GOSUB 6010 ' READ THIS FIELD LENGTH FROM BUFFER
5940 RETURN
6000 '-------------------------- READ ONE FIELD
6010 IN% = 0 ' CHARACTERS ARE READ INTO IN%
6015 PRINT CLS$;COUNT
6018 IN$(COUNT) = ""
6020 FOR LOOP = 1 TO INLENGTH
6030    FIRST% = 3 : SECOND% = 0 : THIRD% = 0
6040    GOSUB 810 ' RECEIVE ONE CHARACTER FROM THE BUFFER
6050    IN% = THIRD% AND 127 ' CHOP OF BIT 8 WITH A BIT MASK
6060    IN$(COUNT) = IN$(COUNT) + CHR$(IN%)
6070 NEXT LOOP
6080 IF COMMA$ <> "Y" THEN 6110
6090    FIRST% = 3 : SECOND% = 0 : THIRD% = 0
6100    GOSUB 810 ' RECEIVE THE COMMA AND DISCARD
6110 COUNT = COUNT + 1
6120 RETURN
7000 ' --------------- EXIT FROM READING DATA
7010 PRINT CLS$;BELL$;
7020 PRINT "DO YOU WISH"
7030 PRINT "EXIT NOW?"
7040 GOSUB 960
7050 IF ANSWER$ = "N" THEN 2130 ' DO NOT EXIT
9000 ' ------- EXIT -------
9010 GOSUB 5110 ' MP LINE LOW
9020 GOSUB 5310 ' RS232 OFF
9030 CLOSE
9040 POKE 77,0 ' CTRL-C IS ENABLED
9070 SYSTEM
```

PROGRAM LISTING
COM.BAS

```
5 ' DATE OF LAST REVISION       July 17, 1986
10 CLS$ = CHR$(26) : BELL$ = CHR$(7) + CHR$(7) : DOS = 8 : ESC$ = CHR$(27)
30 OPTION BASE 1 : ' MAKE THE LOWEST CELL IN ARRAY TO BE ONE
33 WIDTH 255 ' NEEDED TO STOP BASIC FROM INSERTING CARRIAGE RETURNS
36 POKE 77.255 ' CTRL-C DISABLED
40 GOTO 1000
50 ' ********       POSITIONING THE CURSUR     *******START
60 ' *   THE VARIABLES ARE                                *
70 ' *         -- ROWPOS = COLUMN POSITION                *
80 ' *         -- COLPOS = ROW POSITION                   *
90 ' ****************************************************
100 PRINT CHR$(27);"=";CHR$(ROWPOS+31);CHR$(COLPOS+31);
110 RETURN
120 ' ********       POSITIONING THE CURSUR     *********END
130 '
140 ' ********          ENTERING A FIELD        *******START
150 ' *   THE VARIABLES ARE                                *
160 ' *        -- ROWPOS  = COLUMN TO START FIELD IN.      *
170 ' *        -- COLPOS  = ROW TO SRART FIELD IN          *
180 ' *        -- FLEN    = FIELD LENGTH                   *
190 ' *        -- TABLE$  = TABLES OF CHARS TO ACCEPT      *
200 ' *        -- FCT$    = FUNTION KEYS TO ACCEPT         *
210 ' *        -- SPECIAL = SET OF SPEC CHARS TO ACCEPT    *
220 ' ****************************************************
250 GOSUB 100
260 ANSWER$ = ""
270 ENTER$ = ""
280 INST$ = INKEY$
290 IF INST$ = "" THEN 280
300 IF INST$ = CHR$(27) THEN 680
310 IF INST$ = CHR$(13) THEN 730
320 IF INST$ = CHR$(8) THEN 620
330 IF LEN(ANSWER$) = FLEN THEN 590 : ' ** ERROR TRAP **
340 EROR$ = "Y"
350 FOR TABCOUNT = 1 TO LEN(TABLE$)
360 ON VAL(MID$(TABLE$.TABCOUNT.1)) GOSUB 480.510
370 NEXT TABCOUNT
380 IF LEN(SPECIAL$) > 0 THEN GOSUB 560
390 IF EROR$ = "Y" THEN 590 : ' ** ERROR TRAP **
400 ANSWER$ = ANSWER$ + INST$
410 ' NEXT 2 LINES USED TO BLANK FIELD AFTER ONE KEY STROKE
420 IF ENTER$ = "" THEN PRINT SPC(FLEN):GOSUB 100
430 ENTER$ = "BLANKED"
440 PRINT INST$ ;
450 IF LEN(ANSWER$) = FLEN THEN PRINT CHR$(8);
460 GOTO 280
470 ' *******************  TABLE # 1  NUMBERS ONLY ****
480 IF ASC(INST$) > 47 AND ASC(INST$) < 58 THEN EROR$ = "N"
490 RETURN
500 ' *******************  TABLE # 2  ALHABET ONLY ****
510 IF INST$ = " " THEN EROR$ = "N"
520 IF ASC(INST$) >64 AND ASC(INST$) < 91 THEN EROR$ = "N"
530 IF ASC(INST$) >96 AND ASC(INST$) < 123 THEN EROR$ = "N"
540 RETURN
550 ' ************************ SPECIAL CHARACTERS ****
```

```
560 IF INSTR(SPECIAL$,INST$) > 0 THEN EROR$ = "N"
570 RETURN
580 ' ************************************ ERROR TRAP ****
590 PRINT BELL$;
600 GOTO 280
610 ' ******************************** BACKSPACE KEY ****
620 IF LEN(ANSWER$) = 0 THEN 590 : ' *** ERROR TRAP ***
630 IF LEN(ANSWER$) <> FLEN THEN PRINT CHR$(8);
640 ANSWER$ = LEFT$(ANSWER$,LEN(ANSWER$)-1)
650 PRINT " ";CHR$(8);
660 GOTO 280
670 ' ********************************  FCT ROUTINE ****
680 IF LEN(FCT$) = 0 THEN 590 : ' *** ERROR TRAP ***
690 FCTKEY$ = INKEY$
700 IF FCTKEY$ = "" THEN 690
710 IF INSTR(FCT$,FCTKEY$) = 0 THEN 590
720 LET ANSWER$ = CHR$(27) + FCTKEY$
730 RETURN
740 ' ********          ENTERING A FIELD          **********END
800 ' ********          DOS SUBROUTINE            *******START
810 CALL DOS ( FIRST% , SECOND% , THIRD% )
820 RETURN
830 ' ********          DOS SUBROUTINE            **********END
1000 OPEN "R",#1,"FILES.UP",11
1010 FIELD #1,3 AS NUMREC$,8 AS CHECK$
1030 FIELD #1,8 AS BNAME$,3 AS BEXT$
1040 GET #1,1
1050 IF CHECK$ <> "FILES-UP" THEN 1610
1060 NUMFILES = VAL(NUMREC$) - 1
1070 DIM FILNAM$(10),XTEN$(10)
1080 FOR X = 1 TO NUMFILES
1090 GET #1,X+1
1100 FILNAM$(X) = BNAME$
1110 XTEN$(X) = BEXT$
1120 NEXT X
1130 X = 0
1140 X = X + 1
1150 GOSUB 1710
1200 ' ------------- FILE NAME FIELD --------------
1210 ROWPOS=1:COLPOS=1:FLEN=8:TABLE$="12":FCT$="CDX":SPECIAL$=""
1220 GOSUB 250
1230 IF ANSWER$ = "" THEN 1310
1240 IF LEFT$(ANSWER$,1) = ESC$ THEN 1410
1250 FILNAM$(X) = ANSWER$
1300 ' ------------- FILE EXT FIELD --------------
1310 ROWPOS=1:COLPOS=10:FLEN=3:TABLE$="12":FCT$="CDX":SPECIAL$=""
1320 GOSUB 250
1330 IF ANSWER$ = "" THEN 1360
1340 IF LEFT$(ANSWER$,1) = ESC$ THEN 1410
1350 XTEN$(X) = ANSWER$
1360 IF X = NUMFILES + 1 AND FILNAM$(X) = "" THEN 1130
1370 IF X = NUMFILES + 1 THEN NUMFILES = NUMFILES + 1
1380 IF X = 10 THEN 1130
1390 GOTO 1140
1400 ' ------------- FUNCTION KEYS ----------------
```

```
1410 ANSWER$ = RIGHT$(ANSWER$,1)
1420 IF ANSWER$ <> "D" THEN 1520
1430 IF FILNAM$(X) = "" THEN 1150
1440 FOR Z = X TO 9
1450 FILNAM$(Z) = FILNAM$(Z+1)
1460 XTEN$(Z) = XTEN$(Z+1)
1470 NEXT Z
1480 FILNAM$(10) = ""
1490 XTEN$(10) = ""
1500 NUMFILES = NUMFILES - 1
1510 GOTO 1150
1520 RSET NUMREC$ = STR$(NUMFILES+1)
1530 RSET CHECK$ = "FILES-UP"
1540 PUT #1,1
1550 FOR X = 1 TO 10
1560 LSET BNAME$ = FILNAM$(X)
1570 LSET BEXT$ = XTEN$(X)
1580 PUT #1,X+1
1590 NEXT X
1592 CLOSE
1594 IF ANSWER$ = "C" THEN 2010
1596 POKE 77,0 ' CTRL-C ENABLED
1598 SYSTEM
1600 ' ------------ NEW FILE ----------
1610 RSET NUMREC$ = "1"
1620 RSET CHECK$ = "FILES-UP"
1630 PUT #1,1
1640 GOTO 1040
1700 ' ------------- SCREEN PRINT -----------------
1710 PRINT CLS$;
1720 PRINT USING "\      \.\ \";FILNAM$(X);XTEN$(X)
1730 PRINT USING "ON ## OF ##";X;NUMFILES
1740 PRINT "FCT-C = COM"
1750 PRINT "FCT-D = DELETE";
1760 RETURN
2000 ' --------- SET UP "IDENTIF" FILE FOR MEMODOS TO USE -----
2010 OPEN "R",#1,"FILES.UP",11
2020 FIELD #1,3 AS NUMREC$,8 AS CHECK$
2030 FIELD #1,8 AS BNAME$,3 AS BEXT$
2040 GET #1,1
2060 NUMFILES = VAL(NUMREC$)-1
2070 OPEN "I",#2,"IDENTIF"
2080 OPEN "O",#3,"IDENTIF.BAK"
2090 OVER$ = INPUT$(28,#2)
2100 PRINT #3,OVER$; ' ";" MAKES NO <CR>
2110 JUNK$ = INPUT$(1,#2) ' ERASE NUMBER OF FILES IN IDENTIF
2120 PRINT #3,CHR$(NUMFILES);
2130 FOR X = 1 TO NUMFILES
2140 GET #1,X+1
2150 PRINT #3,CHR$(1);BNAME$;BEXT$;CHR$(1);CHR$(0);CHR$(0);
2155 NEXT X
2160 CLOSE
2170 KILL "IDENTIF"
2180 NAME "IDENTIF.BAK" AS "IDENTIF"
2190 PRINT CHR$(253)
```

```
2195 POKE 77,0 ' CTRL-C ENABLED
2210 OUT 3,13 ' MP LINE LOW
2220 FIRST% = 91 : SECOND% = 0 : THIRD% = 0
2230 GOSUB 810 ' RS232 DISABLED
2240 SYSTEM
```

ID - 160 station ID	1
ET - Elapsed sample Time	8
SD - Stabalization Delay	2
B - Baseline	2
O - Overconcentration	2
ST - Self Test	2
AR - Alarm Rate	2
A1 - Alarm 1	2
A2 - Alarm 2	2
C1 - Chanal 1	7
C2 - Chanal 2	7
C3 - Chanal 3	7
C4 - Chanal 4	7
C5 - Chanal 5	7
C6 - Chanal 6	7
	65

PROGRAMMER'S GUIDE

MONO RESEARCH LABORATORIES LTD.

1- INTRODUCTION

- THE COMPONENTS OF MEMODOS.

MEMODOS IS MADE OF TWO MAIN COMPONENTS:

A) THE STANDARD CP/M VERS. 2.2 OPERATING SYSTEM FROM DIGITAL RESEARCH

B) A PROPRIETARY TELECOMMUNICATION SYSTEM COMPLETE WITH NAMED FILE TRANSFERS CAPABILITY, MODEM CONTROL, ERROR DETECTION AND CORRECTION PROTOCOL, USER CONFIGURABILITY AND COMPLETELY UNADORNED OPERATION UNDER USER PROGRAM CONTROL.

- THE CP/M ENVIRONMENT.

THE NSC-800 PROCESSOR OF THE MEMO UNIT IS Z-80 COMPATIBLE. THIS MAKES IT AN 8 BITS PROCESSOR WITH 64K ADDRESSING CAPABILITY.

IN A CP/M CONTEXT THE OPERATING SYSTEM RESIDES IN UPPER MEMORY AND RESERVES THE LOWER 100H BYTES FOR VARIOUS SYSTEM FLAGS AND INTERRUPT VECTORS. THUS A USER PROGRAM IS LOADED FOR EXECUTION AT ADDRESS 100H AND MAY EXTEND UP TO THE BASE OF THE OPERATING SYSTEM. EVERY STANDARD ASSEMBLER, COMPILER AND LINKER GENERATES CODE FOR THAT ADDRESS UNLESS OTHERWISE INSTRUCTED.

MEMORY MAP OF MEMODOS:

```
!    FFFFH     > UPPER MEMORY
!    FFFDH     > EXTENDED JUMP TABLE
!    FB00H     > RESERVED BY MEMODOS
-----------------
!              > MEMODOS
!
!    BC06H     > BASE OF MEMODOS
-----------------
!
!
!
!              > USER PROGRAM AREA
!
!
!    0100H     > BASE OF USER AREA
-----------------
!    00FFH
!    0000      > RESERVED BY MEMODOS
```

THE RESERVED AREA WILL BE DESCRIBED IN DETAIL IN A LATER CHAPTER. WE WILL JUST MENTION FOR THE MOMENT THAT ADDRESS 5 CONTAINS A JUMP TO THE ENTRY POINT OF MEMODOS. THIS ALLOWS ANY PROGRAM TO ACCESS THE OPERATING SYSTEM THROUGH A SIMPLE CALL TO ADDRESS 5 WITHOUT HAVING TO KNOW EXACTLY WHERE IT RESIDES IN MEMORY.

IT ALSO ALLOWS A PROGRAM TO COMPUTE EXACTLY HOW MUCH MEMORY IT HAS TO ITSELF. ADDRESSES 6 AND 7 CONTAIN THE ADDRESS OF THE ENTRY POINT OF MEMODOS AND A USER PROGRAM OWNS ALL MEMORY BETWEEN 100H AND THIS POINTER VALUE.

- THE MEMODOS ENVIRONMENT.

SINCE MEMODOS USES CP/M AS A BASIC COMPONENT AND ADDS ITS OWN EXTENTIONS, ONE CAN SAY AS A GENERAL RULE THAT THE TECHNICAL PUBLICATIONS ABOUT CP/M FROM DIGITAL RESEARCH AND OTHER SOURCES CAN BE USED A REFERENCE MATERIAL FOR MEMODOS.

THERE IS ONE SLIGHT DIFFERENCE HOWEVER. UNDER MEMODOS ALL LOGICAL DRIVE NAMES, FROM A: TO P:, REFER TO THE SAME PHYSICAL DRIVE A:. IT WOULD BE QUITE USELESS TO SPLIT A 32K OR EVEN A 320K DISK SPACE INTO NUMEROUS SMALLER DRIVES; YET SOME EXISTING PROGRAMS MAY USE MORE THAN ONE DRIVE. THESE CAN STILL REFER TO DRIVE B: EVEN THOUGH THE DATA ACTUALLY GOES TO OR COMES FROM DRIVE A:. NO SIGN OF PROBLEMS HAVE OCCURED SO FAR FROM THIS CHANGE IN THE STANDARD BEHAVIOUR.

2- PROGRAM DEVELOPMENT.

- CHOOSING A DEVELOPMENT SYSTEM.

ANY STANDARD CP/M COMPUTER CAN GENERATE A PROGRAM EXECUTABLE 3Y THE MEMO UNIT. IF YOU ALREADY OWN SUCH A SYSTEM YOU CAN USE IT TO PRODUCE YOUR OBJECT CODE AND TEST IT THOUROUGHLY.

THE NEXT STEP WILL BE TO TRANSFER IT TO YOUR IBM PC OR COMPATIBLE COMPUTER FOR LATER DOWNLOAD TO YOUR MEMO UNITS. YOU MUST HAVE OR WRITE A PROGRAM TO PERFORM THE TRANSFER BETWEEN YOUR DEVELOPMENT SYSTEM AND YPUR PC.

IT WOULD BE SIMPLER AND FASTER TO DOWNLOAD DIRECTLY FROM YOUR DEVELOPMENT SYSTEM OVER TO THE MEMO UNIT. IT IS NOT PRACTICALLY FEASIBLE HOWEVER TO ADAPT DIGITEL TO EACH AND EVERY VARIANT OF SUCH SYSTEMS ON THE MARKET.

THE MOST ELEGANT DEVELOPMENT SYSTEM WOULD BE A SYSTEM THAT COMBINES THE CAPABILITIES OF BOTH THE IBM PC AND THE MEMO UNIT. YOU CAN DO JUST THAT BY ADDING A Z-80 CARD WITH CP/M TO YOUR PC. THERE ARE A NUMBER OF THESE ON THE MARKET. WE HAVE TESTED THE BABY BLUE CARDS FROM MICROLOG AND MANY OF OUR CLIENTS USE THEM VERY SUCCESSFULLY.

WITH HTIS CONFIGURATION YOUR COMMUNICATION SYSTEM (IBM-PC / DIGITEL) DOUBLES-UP AS A MEMO-COMPATIBLE DEVELOPMENT SYSTEM.

3- CONTROLING YOUR TERMINAL.

- FAST SCROLL, SLOW SCROLL AND NO SCROLL.

WITH SUCH A SHORT SCREEN LENGHT (4 LINES) THE SCROLLING FUNCTION MUST BE SLOWED DOWN IF THE USER IS TO SEE ANYTHING.

ADDRESS 4CH (76 DECIMAL) ALLOWS YOU TO CONTROL THE SCROLL MODE. A VALUE OF 0 YELDS A FAST SCROLL, OFEH A SLOW SCROLL AND OFFH PREVENTS SCROLLING ENTIRELY.

- CURSOR ADDRESSING AND SCREEN PRESENTATION.

THE CURSOR ADDRESSING SEQUENCE OF THE MEMO SCREEN IS SIMILAR TO THE TELEVIDEO 910.

```
                ESC = R C

        WHERE   ESC -> 27H
                =   -> 3DH
                R   IS THE ROW NUMBER WITH A OFFSET OF 20H
                C   IS THE COLUMN NUMBER WITH AN OFFSET OF 20H
```

EX: ESC = BLANK BLANK WILL POSITION THE CURSOR AT THE HOME POSITION (UPPER LEFT CORNER).

SENDING 07H TO THE SCREEN WILL CAUSE MEMO TO BEEP FOR .5 SECOND.

- FILTERING CTRL-C.

MANY PROGRAMS WRITTEN FOR CP/M WILL ABORT UPON ENTERING CTRL-C ON THE KEYBOARD. THIS CAN BE PREVENTED UNDER MEMODOS BY STORING OFFH AT ADDRESS 4DH. NORMAL CTRL-C OPERATION CAN BE RESTORED BY STORING 00 AT THE SAME ADDRESS.

4- SAVING ENERGY.

NO POWER ON/OFF SWITCH HAS BEEN PROVIDED ON THE MEMO UNIT. THIS WAS DONE TO FREE THE USER FROM HAVING TO WORRY ABOUT THE BATTERIES OF HIS UNIT AND TO PREVENT PROGRAM INTERRUPTION IN THE MIDTS OF EXECUTION.

IN ORDER TO ACHEIVE A COMPACT AND LIGHTWEIGHT HOWEVER, IT IS VITAL TO ECONOMIZE ENERGY AS MUCH AS POSSIBLE.

DURING A FULL DAY OF NORMAL USE THE CPU IS ACTUALLY ACTIVE FOR ONLY A FRACTION OF THE TIME.

MEMO HAS THE CAPABILITY OF PLACING ITSELF IN A POWER-SAVE MODE WHENEVER IT IS NOT IN USE. IN THIS MODE, ALL INTERNAL OPERATIONS ARE SUSPENDED EXCEPT FOR THE SYSTEM CLOCK. ONLY MINIMAL ENERGY IS MAINTAINED TO ASSURE PROGRAM AND DATA RETENTION IN THE MEMORY UNIT.

HERE IS A BRIEF DESCRIPTION OF THE MECHANISM TO IMPLEMENT THIS FEATURE.

KEYBOARD OPERATIONS INDICATE THAT THE PROGRAM NEEDS DATA AND CANNOT PROGRESS UNTIL IT HAS BEEN KEYED-IN.

I/O OPERATIONS TO THE DISPLAY OR TO THE RAM DISK INDICATE THAT ACTIVITY IS EXPECTED FROM THE CPU.

SOME LANGUAGE IMPLEMENTATIONS FREQUENTLY TEST THE KEYBOARD STATUS IN CASE THE USER MIGHT REQUEST PROGRAM INTERRUPTION.

EACH KEYBOARD STATUS CHECK START A TIMER WITH AN INITIAL VALUE (IF IT IS NOT ALREADY RUNNING) AND EACH OTHER TYPE OF I/O OPERATION STOPS IT.

IF THE TIMER REACHES ZERO THE CPU IS AUTOMATICALLY PUT IN THE POWER-SAVE MODE UNTIL THE NEXT KEY-STROKE. THUS YOU HAVE A RACE BETWEEN THE TIMER AND THE OTHER I/O OPERATIONS. MOST LANGUAGE IMPLEMENTATIONS ONLY TEST THE KEYBOARD BEFORE OR AFTER DISK ACCESS. THIS MAKES IT A VERY SHORT RACE AND THE TIMER ALWAYS LOOSES. A PROBLEM ARISES HOWEVER WITH SOME BASIC IMPLEMENTATIONS WHERE THE KEYBOARD IS TESTED BETWEEN MOST SOURCE INSTRUCTIONS. IF A PROGRAM ACCEPTED DATA FROM THE KEYBOARD AND THEN PERFORMED LONG CALCULATIONS ON IT, YOU WOULD HAVE A TIME-OUT CONDITION AND THUS A POWER-SAVE MODE BEFORE THE PROGRAM WOULD DO ANY I/O. THESE CALCULATIONS WOULD NEVER COMPLETE AND YOU WOULD THINK THAT YOUR PROGRAM IS LOOPING.

ON THE OTHER HAND, WHEN THE PROGRAM IS REALLY WAITING FOR DATA, IT TESTS THE KEYBOARD AND DOES NOTHING ELSE UNTIL YOU ENTER SOMETHING. IF YOU HAD A SLEEP VALUE LOADED INTO THE TIMER OF 5 MINUTES AND YOU ENTERED DATA ONLY EVERY 5 MINUTES, YOUR CPU WOULD BE WORKING ALL THE TIME, TESTING THE KEYBOARD WHILE ACTUALLY

PROCESSING THE DATA CAN REQUIRE ONLY MICRO OR MILLI-SECONDS.

THE SLEEP VALUE LOADED IN THE TIMER DETERMINES HOW LONG THE UNIT WILL HAVE ITS KEYBOARD TESTED BEFORE GOING IN POWER-SAVE IF NO I/O OCCURS. THIS VALUE IS FACTORY SET AT 0AH FOR A DURATION OF 10 SECONDS. IT IS FAR TOO LONG FOR MOST APPLICATIONS BUT LETS YOU GET SOME EXPERIENCE WITH THE UNIT BEFORE YOU HAVE TO WORRY ABOUT THIS DETAIL.

MEMODOS ALLOWS YOU TO CONTROL THIS PARAMETRE, AND AS AN APPLICATION PROGRAMMER YOU ARE EXPECTED TO FINE-TUNE YOUR SYSTEM FOR MAXIMUM PERFORMANCE AND MINIMUM ENERGY REQUIREMENT. THE SLEEP VALUE LOADED IN THE TIMER IS READ FROM ADDRESS 50H.

YOU CAN DISABLE THIS MECHANISM COMPLETELY BY STORING ZERO IN THIS LOCATION. THE AUTONOMY OF YOUR UNIT WOULD OF COURSE BE GREATLY REDUCED BUT FREEDOM COMES WITH RESPONSIBILITY.

STORING A VALUE OF 0FFH WILL SET THE MEMO IN POWER-SAVE AS SOON AS THE KEYBOARD IS TESTED AND NO KEY HAS BEEN PRESSED. THIS CAN BE USED FOR GREATHER POWER ECONOMY IF YOUR LANGUAGE IMPLEMENTATION DOES NOT TEST THE KEYBOARD UNLESS YOU SPECIFICALLY PROGRAM IT IN YOUR APPLICATION.

MEMO LETS YOU KNOW WHEN IT IS GOING IN POWER-SAVE MODE BY PLACING ITS CURSOR IN THE UPPER LEFT CORNER OF THE SCREEN. IT RESUMES ITS ORIGINAL POSITION WHEN YOU HIT ANY KEY.

FOR USER COMFORT, YOU CAN DISABLE THIS CURSOR REPOSITIONNING FUNCTION ONCE YOU HAVE OPTIMIZED THE POWER CONSUMPTION OF YOUR APPLICATION. STORING A VALUE OF 0FFH WILL DISABLE IT WHILE A VALUE OF 0 WILL ENABLE IT. IN BOTH CASES THE AUTOMATIC POWER-SAVE MECHANISM WILL FUNCTION AS DESCRIBED ABOVE.

5- EXTENDED FUNCTIONS OF MEMODOS.

A NUMBER OF FEATURES OF YOUR MEMO UNIT ARE NOT SUPPORTED BY THE STANDARD CP/M OPERATING SYSTEM.

THESE ARE MADE AVAILABLE TO YOU THROUGH A SPECIAL JUMP TABLE WHICH ADHERES AS MUCH AS POSSIBLE TO THE STANDARD CP/M CALL CONVENTION EXCEPT FOR ITS ADDRESS. CP/M SYSTEM CALLS ARE MADE THROUGH ADDRESS 5 WITH THE FUNCTION NUMBER IN REGISTER C AND THE PARAMETER IN REGISTER PAIR DE. MEMODOS EXTENDED SYSTEM CALLS ARE MADE IN THE SAME WAY EXCEPT THAT THE ADDRESS CALLES IS 0FFFDH.

SOME OF THE FUNCTIONS ARE VERY DELICATE TO USE AND ARE INTENDED FOR VERY SPECIAL APPLICATIONS ONLY SUCH AS PROCESS CONTROL... THESE ARE DETAILED IN A PUBLICATION TITLED "ADVANCED PROGRAMMING INFORMATION".

THE FOLLOWING TABLE LISTS THE MORE COMMON EXTENDED FUNCTIONS YOU MAY NEED. REGISTER C CONTAINS THE FUNCTION NUMBER WHILE REGISTER E CONTAINS 1 BYTE PARAMETRES AND REGISTER PAIR DE CONTAINS 2 BYTES PARAMETRES. THE RESULT IS PASSED TRHOUGH REGISTER A OR A SPECIFIED ADDRESS.

ALONG WITH VARIOUS FLAGS INDICATING THAT THIS UNIT CONTAINS NO OPERATING SYSTEM OR USER PROGRAM.

THE FOLLOWING TABLE GIVES A RECORD DESCRIPTION OF THE FILE IDENTIF:

FIXED SECTION MANAGED BY MEMODOS AND THE USER

```
PGID:    DS      1        TYPE OF APPLICATION
PGVERS:  DS      1        PROGRAM VERSION
ROUTE:   DS      6        ROUTE NUMBER
TYTEL:   DS      1        TYPE OF TELECOMMUNICATION
NOTEL:   DS      8        TELEPHONE NUMBER
MAXTRY:  DS      1        MAXIMUM NUMBER OF RETRYS
FILENT:  DS      0A       FILLER
NFILES:  DS      1        NUMBER OF FILES DEFINED IN FOLLOWING
                          SECTION
             ++++++++
             1D BYTES
```

VARIABLE SECTION MANAGED BY USER AND DIGITEL
ONE DESCRIPTOR OF 5 FIELDS EACH PER FILE

```
DRFIL:   DS      1        FILE DRIVE
NAMFIL:  DS      8        FILE NAME
EXFIL:   DS      3        FILE NAME EXTENTION
TYPFIL:  DS      1        FILE TYPE
NBLOKS:  DS      2        NUMBER OF BLOCKS
             ++++++++
             OF BYTES
```

THIS RECORD DESCRIPTION FOLLOWS THE Z80 ASSEMBLER NOMENCLATURE WHERE DS MEANS DEFINE STORAGE AND THE HEXADECIMAL VALUE IS THE NUMBER OF BYTES RESERVED FOR THAT VARIABLE.

PGID PROGRAM IDENTIFICATION NUMBER FROM 1 TO OFF.

PGVERS PROGRAM VERSION NUMBER.

THESE 2 VALUES MUST BE SET TO A NON ZERO VALUE BEFORE TELECOMMUNICATION OTHERWISE THE PC WILL CONSIDER YOUR UNIT HAS NO PROGRAM YET AND PROCEED WITH THE DOWNLOAD OF EVERY O/S, PROGRAM AND DATA FILE FOR THAT UNIT ON EVERY COMMUNICATION.

ROUTE ROUTE NUMBER ENTERED AFTER A RESET. THIS NUMBER IDENTIFIES YOUR MEMO UNIQUELY FOR THE PC.

TYTEL REFERS TO THE TYPE OF COMMUNICATION AS AUTOMATIC (MEMO WAITS FOR PC TO CALL) OR MANUAL (USER INSTRUCTS MEMO TO CALL THE PC IMMEDIATELY). THIS FIELD IS SET BY MEMODOS AND THE PROGRAMMER NEEDS NOT TO SET IT TO ANY SPECIFIC VALUE.

6- THE TELECOMMUNICATION PROCESS.

- THE 4 PHASES OF TELECOMMUNICATION.

A COMPLETE TELECOMMUNICATION CYCLE OCCURS IN 4 SPECIFIC PHASES:

1- ENQUIRY

2- EXCHANGE OF IDENTIFICATION RECORDS

3- UPLOAD (IF REQUIRED)

4- DOWNLOAD (IF REQUIRED)

1- THE ENQUIRY PHASE IS ACCOMPLISHED BY THE CALLING COMPUTER (MEMO OR PC) SENDING A SPECIFIC STRING OF CHARACTERS.

2- THE EXCHANGE OF IDENTIFICATIONS PHASE IS DIVIDED IN 2 STEPS:

A) MEMO SENDS ITS OWN I. D. SO THAT THE PC KNOWS WHO IS TALKING AND WHAT UPLOAD TO EXPECT.

B) THE PC SENDS ITS I. D, CONFIRMING THE EXPECTED UPLOAD AND TELLING MEMO WHAT DOWNLOAD TO EXPECT.

WHICHEVER COMPUTER IS THE CALLING UNIT (SENDS ENQUIRY STRING) MEMO ALWAYS SENDS ITS I. D. FIRST. THIS ALLOWS CHECKING FOR POSSIBLE FILES TO DOWNLOAD TO A GIVEN MEMO UNIT. IT ALSO PREVENTS LETTING THE PC SEND DATA TO AN UNIDENTIFIED PARTY.

3- ONCE BOTH UNITS ARE SATISFIED OF EACH OTHERS IDENTITY, THE NEXT STEP IS TO COLLECT YOUR UPLOAD. THIS CAN BE ONE OR MORE SEPARATE FILES TO BE SENT TO THE PC.

4- THE DOWNLOAD MAY CONSIST OF 3 DIFFERENT TYPES OF FILE.

A) A NEW VERSION OF THE OPERATING SYSTEM (MEMODOS).

B) A NEW VERSION OF THE APPLICATION PROGRAM.

C) DATA FILES OF ANY TYPE NEEDED BY THE APPLICATION PROGRAM.

- THE FILE IDENTIF

THE ENTIRE COMMUNICATION PROCESS IS CONTROLED BY A USER ACCESSIBLE FILE CALLED IDENTIF. THE FILE IS ORIGINALLY CREATED BY MEMO AFTER A RESET. THE UNIT ASKS THE USER TO ENTER A ROUTE NUMBER OF 6 DIGITS. THAT NUMBER IS STORED IN THE IDENTIF FILE

REG. C	REG. PAIR DE	RESULT	DESCRIPTION
44	NONE	ADD. 55	TELECOMMUNICATION FUNCTION. ADDR. 55 = 0 -> TEL. OK ADDR. 55 = 0FE -> USER INTERRUPTED.
46	0, 1, 2, 3	NONE	SET BAUD RATE ACCORDING TO REGISTER E. 0 -> 300, 1 -> 1200, 2 -> 1800, 3 -> 2400
4C	NONE	TONE	KEYBOARD CLICK
4D	NONE	TONE	BEEP
4E	NONE	TONE	DOUBLE BEEP AT LOWER PITCH
51	NONE	TIME SET	TAKES DATE AND TIME INFORMATION AT ADDR. 45H AND SETS SYS CLOCK
52	NONE	RD. TIME	READ SYSTEM CLOCK AND STORE AT ADDRESS 45H
59	NONE	BAUD RATE SET	DISPLAYS BAUD RATE SELECTION MENU, ACCEPTS USER INPUT AND SETS BAUD RATE

NOTEL RESERVED FOR FUTURE USE. WILL ALLOW THE PROGRAMMER TO PRE-DETERMINE A PHONE NUMBER THAT MEMO WILL DIAL USING A SPECIAL MODEM.

ESSMAX AUTOMATICALLY SET TO 3 BY MEMODOS. THIS IS THE NUMBER OF TIMES MEMODOS AND DIGITEL WILL RETRANSMIT AN ERRONEOUS BLOCK OF DATA BEFORE ENDING COMMUNICATION.

FILENT NOT CURRENTLY USED. RESERVED.

NFIL THE NUMBER OF FILES DECLARED IN THE FOLLOWING SECTION. IF YOU WISH TO UPLOAD 3 DATA FILES YOU STORE 3 IN THIS FIELD AND FILL 3 OCCURENCES OF DRFIL, NAMFIL, FILEXT, TYPFIC AND NBLOCKS.

DRFIL CP/M DRIVE NUMBER. 0 = CURRENT, 1 = DRIVE A:... SHOULD BE SET TO 0 OR 1 FOR DRIVE A:.

NAMFIL FILE NAME. 8 ASCII CHARACTERS, LEFT JUSTIFIED.

FILEXT CP/M FILE EXTENTION. 3 ASCII CHARACTERS, LEFT JUSTIFIED. SHOULD BE BLANK AS IT WILL CONTAIN THE LAST 3 DIGITS OF THE ROUTE NUMBER WHEN THE PC RECEIVES THAT FILE AND STORES IT ON DISK.

TYPFIL FILE TYPE. YOU MUST USE ONLY 1. THIS WILL INSTRUCT MEMODOS TO UPLOAD THIS FILE. ANY OTHER VALUE WILL CAUSE MEMODOS TO IGNORE IT.

NBLOKS THE NUMBER OF 128 BYTES BLOCKS THIS FILE CONTAINS. MUST BE SET TO ZERO BY THE USER PROGRAM. THIS FIELD WILL BE FILLED BY MEMODOS BEFORE TRANSMITTING ITS IDENTIFICATION.

AS AN APPLICATION PROGRAMMER, IF YOU WISH TO UPLOAD 2 FILES, DATA1 AND DATA2, YOU MUST READ IN THE FIRST RECORD TO GET THE ROUTE NUMBER. YOU THEN SET NFIL TO 2 AND ALL THE OTHER FIELDS AS PER ABOVE AND THEN REWRITE THIS RECORD. ADDITIONNAL FILES MAY BE DESCRIBED FOR A MAXIMUM OF 353D BYTES TOTAL FOR THE FILE IDENTIF.

- INITIATING THE TELECOMMUNICATION PROCESS.

ALL DATA FILES USED BY YOUR PROGRAM MUST BE CLOSED BEFORE TELECOMMUNICATION. THERE ARE 2 WAYS TO INITIATE THE PROCESS:

A) AN ASSEMBLY LANGUAGE CALL TO THE EXTENDED JUMP TABLE WITH FUNCTION NUMBER 44H.

B) SENDING 0FEH TO THE CONSOLE.

THE SECOND METHOD IS THE EASIEST IF YOU ARE USING A BASIC INTERPRETER BUT FOR SOME REASONS IT WILL NOT WORK WITH ALL LANGUAGE IMPLEMENTATIONS.

PROGRAM EXECUTION WILL RESUME NORMALLY AFTER THE

COMMUNICATION IS COMPLETE. YOU CAN TEST THE SUCCESS OR FAILURE OF YOUR COMMUNICATION BY EXAMINING THE CONTENTS OF ADDRESS 55H. A ZERO MEANS SUCCESS AND 0FEH MEANS THAT AN INTERRUPTION OF THE PROCESS WAS REQUESTED BY THE USER BY HITTING THE FCT KEY.

APPENDIX
- MEMORY LOCATIONS OF INTERREST.

```
ANNEES   EQU     45        BCD FORMAT
MOIS     EQU     46         "     "
JOURS    EQU     47         "     "
SEMAINE  EQU     48        DAY OF THE WEEK ( 0 - 6 )
HEURES   EQU     49        BCD FORMAT
MINUTES  EQU     4A         "     "
SECON    EQU     4B         "     "
FASTSCR  EQU     4C       ; 0 = FAST, OFE = SLOW, OFF = NO SCROLL
CTRLC    EQU     4D       ; 0 = CONTROL C ALLOWED
MBQ      EQU     4E       ; MAXIMUM NUMBER OF STORAGE BANKS
BAUD     EQU     4F       ; CURRENT BAUD RATE
SLEEP    EQU     50       ; NUMBER OF SECONDS BEFORE POWER SAVE
DMA      EQU     51       ; RESERVED
LONG     EQU     53       ; RESERVED
STATUS   EQU     55       ; SUCCES DU TRANSFER
CURSLEP  EQU     56       ; 0 = CURSOR HOME WHEN IN POWER SAVE
```

MEMO

1- INTRODUCTION

- WHAT IS MEMO?

Memo is a portable microcomputer equiped with a CMOS Z80 compatible CPU. It has internal rechargeable batteries, a full ACSII keyboard, 4 lines of 16 characters display and can address up to 384k of memory.

Memo will work for 2 full days of normal data entry without recharge. After that period, if your batteries run low,
Memo will inform you that it needs recharging, lock up its keyboard and retain program and data 2 more full days. It will automatically resume normal operations as soon as the batteries
reach a sufficiently high level.

In normal operation, you would do your daily work and then slip it in your briefcase or concentrator for communication and for nighlty recharge.

Memo is staticproof, waterproof, and impactproof and will operate under extreme temperature conditions from -40C
to +60C. It is built of the highest quality materials throughout including computer-designed fiberglass PCBS, rugged policarbonate case and thick gold plated connectors for minimum maintenance and long term reliability.

The accessories available with Memo include:

- a briefcase with:
  - . a battery charger for Memo
  - . a communication modem (300 - 1200 baud, acoustic coupler or direct connect)
  - . a printer (thermal or impact with up to 120 CPS bidirectionnal printing)

- a 5-slots concentrator. It can recharge 5 Memos allows telecommunication for each one sequentially. As many concentrators as needed can be cascaded on one phone line without physical limit.

- a 2-slots concentrator similar to the above.

- a portable accessory holder that Memo plugs into. It can contain a number of options such as a mini-printer, a modem module, an eeprom module for infinite data retention...

- WHAT IS MEMODOS?

Memodos is the main operating system for your Memo computer. It is made of 2 interacting components: the industry standard CP/M operating system and a full telecommunication package. It allows you to program Memo in any programming language of your choice from Assembler to Cobol or Dbase II and completely relieves you of all the chores and complexities of computer telecommunications so you can quickly get ahead with your application development and achieve predictable results.

- WHAT IS DIGITEL?

Digitel is a serie of programs that run any standard IBM/PC or compatible unit. It is designed to handle telecommunications with Memo and manage its program and data files automatically.

Its protocol and lock verification scheme mirrors the Memo's and allows it to transfer files of any type over standard telephone lines efficiently and reliably.

Each file is separated into blocks transmitted and verified individually for total data integrity.

- THE ENTIRE SYSTEM

Memo, Memodos and Digitel interact intimately to form a complete and homogenous distributed data processing network.

Its flexible architecture, rugged design and modular structure provide poweful computing capabilities at your fingertips whenever you need it and wherever you are.

The simplest configuration could be 1 or 2 Memos and briefcases used in remote locations and communication with a PC for sales data collection and processing. The same basic set-up can be expanded to 400 or 500 Memos communicating to a number of distributed PCS, each in turn transfering their data over to your mainframe computer for integrated processing.

2- A HARD WORD

Memo is contained in a sealed 2-parts policarbonate case that affords the ruggedness needed to make it a reliable work tool. Like any hand-held component, Memo is likely to be dropped and should withstand such treatement without damage or loss of data.

All computers are affected by static electricity. -- all but Memo -- just by walking on a carpet on a dry day, you may accumulate up to 100 000 volts of static charge within your body and your hand-held computer. Special techniques were used at the design stage of Memo to dissipate it gradually in such a way that your computer is protected from its adverse effects and you will not loose your program and data.

You certainly do not intend to equip your sales force with something like a football, but you still need a computer that can be used in actual - real life - situations and Memo is the most practical and dependable portable computer available on the market today.

It is composed of 3 main modules:

A) keyboard and display

B) CPU and I/O

C) memory.

The keyboard/display module can be either of the LCD type for minimum energy requirements and high readability under strong lighting conditions (-30C to +60C) or the led type for extra mechanical ruggedness and operation under very low temperature conditions (-40C to +60C).

Keeping the CPU and I/O functions on a separate module insures against obsolescence. Memo is currently equipped with 1 serial I/O channel is multiplexed to drive a printer, eeprom storage or a modem. You will always be able to upgrade your network with the latest technology as it becomes available.

The memory is available in increments of 32k up to a maximum of 384k. A Memo can be purchased with 64k to start with and be later upgraded as your needs increase.

3- A SOFT WORD

Memo comes off the assembly line with a basic operating system and telecommunication package in ROM, ready for use.

This operating system is a CP/M emulator that includes most of its character-oriented functions but none of the disk oriented functions. It is very compact and efficient and allows you to write simple applications in Assembler or somme high level languages that do not query the disk system. PL1, Fortran and Pascal have been used successfully in this fashion on machines of 64k memory. The upload data is stored in arrays and transferred through the telecommunication package and no download files are allowed.

The full power of Memo however is available under Memodos.

As mentioned earlier, Memodos is a combination of the industry standard CP/M operating system and a powerful and flexible file-oriented communication package.

It occupies about 17k and leaves you with over 48k for program execution. It handles all of CP/M standard function calls plus a number of support routines tailored for optimum use of these are detailed in the programmer's guide.

Memodos also maintains a number of parameters in user accessible lower memory addressees that indicate the total amount of disk space, current baud rate... through this area the user can also set certain operating parameters such as - allow / fiter CTRL C - ...

The RAM disk of Memodos behaves exactly like any standard disk system in a CP/M disk environment. You can create or destroy files from Basic, Cobol or Dbase for that matter or do any system maintenance required.

The size of the Ram disk is currently from 32k to 320k, expandable in 32k increments. Memodos will automatically evaluate the space available and configure its disk accordingly.

You can use vitually any language or package available on the market for standard CP/M machines. The only limitations would have to do with the keyboard or display.

For example, the keyboard of Memo is optimized for field data entry and does not include such keys as commas or paranthesis. Similary it would be rather awkward to use programs like word star or multi plan on 4 x 16 display. These, however, will run perfectly if you connect a standard ASCII terminal to your Memo, of course at the cost of portability.

The choice of the actual language you will be using depends on factors like the habits and preferences of your data processing personnel, the size of your programs as well as the size and format of your data files.

THE POWER OF MEMODOS

Memodos is a fast and efficient operating system for Memo. It is fully CP/M compatible, it allows you to utilize all the features of your Memo through extended system calls and provides you with a complete file-oriented telecommunication system; you only supply the names of the files you want transferred and call the telecommunication function.

Memodos will supervise the process form thereon, ensure that your data is transmitted or received accurately and give you full status on its operations. No special programming effort is required. Each file is separated into 128 bytes blocks individually detected, even a power failure will cause the system to wait for return of normal conditions and be ready for retransmission without data loss.

HOW TO PROGRAM MEMO?

To write a program for Memo, you need a standard CP/M machine that you will use as a development system.

You also need a communication system to transfer your programs and data to Memo.

The Baby Blue card for the IBM/PC contains a Memo-compatible Z80 processor. You use it to write, compile and debug your programs. A well-thought-out screen presentation is recommended here. In most casess a 16 X 4 display are is a quite sufficient display area. Ancilliary data such as the current customer number displayed along with the request for a specific input field kile the - ship to address - will keep operationof your program easy to understand even though you cannot display as much as you would on a full-size screen. Means of reviewing an order or an invoice just entered before final acceptance must be provided. But the key to success lies in the overall simplicity and clarity of the program.

You must bear in mind that the final user is likely to work with your program outside a regular office environmment, thus without help available, and may have never been connected in any way to even the simplest form of computer operation.

He is likely to be timid at first, considering that the day-to-day operations he has always done on paper should be done the same way on a computer. This is a normal reaction you expect from your office personnel. When they start using your program, you or your data processing staff are close at hand if any problem should arise but this is not the case for the normal in-the-field Memo user.

You can go a long way in alleviating his worries. You want that program fully tested ans as bug free as possible so the user does not get frustrated by a machine that has been unpredictable for the first 3 months he used it. A proper training period should of course be planned.

Memodos will start or resume program execution automatically after telecommunication so he will not even have to give a single command that is not part of a menu.

But most of all, carefully structured program execution logic and well planned screen presentation will ease him smoothly into perceiving his computer as a useful tool rather than as a challenge to his ability to cope with a new technology.

In fact the average Memo user is the easiest candidate to sell to the idea of computerized operation because he can see how much time he will save performing tidy tasks like balancing his dailly sales...

Another convincing element is that the computer will improve the pride he has in his job. It has been found that the average user feels his status has been enhanced whether he works on delivery, is a sales representative or performs on-site data collection of any kind.

4- THE IBM/PC

THE NEED FOR A COMMUNICATION FRONT-END

For Memodos to be able to execute a complete communication cycle with named files transfers, block verification ... It has to talk, to another computer that uses the same protocol, mirroring Memo's actions. That computer also has to be able to identify which Memo it is talking to, contain the files you want downloaded to your various users as well as store their uploaded data and retreive it in an ordely fashion for further processing.

DIGITEL

Digitel is a set of programs that run on any IBM/PC or compatible computer.

It allows you to - declare - the Memos you want to have access to your network and assign the program and data files you want downloaded to them.

It gives you a printed list of the files that have been assigned to a given Memo for download as well as those that have been uploaded an a printed report fo the performance statistics of your telephone lines.

Such statistics include the number of blocks transferred, the time necessary to do so and the total number of errorrs that occured.

This facilitates system management by letting you measure overall network traffic. It also provides you with qualitative data on line performance and allows you to detect and demonstrate to your telephone company a possible degradation of that line.

PROTOCOL

A communication protocol is a set of procedures by which two computers can exchange informations in an ordely fashion. This is done through a set of logical functions:

- establish and verify that a communication link exists;
- establish and verify the identity of the calling or called computer;
- define the order of precedence of the various data transfers;
- perform data blocking;
- detect data transmission errors and retrie blocks as required;
- detect fatal transmission interruptions and automatically re-establish the communication link;
- permit remote control of data concentrators in case of multiple Memos stations;
- permit remote control of program and data files residing in each individual Memo.

5- DEFINING YOUR NEEDS IN MEMORY

MEMORY MAP OF MEMODOS

A Z-80 CPU can address up to 64K of memory for program execution. Thus Memodos and your program will reside in that area while the rest of your memory will be used for data storage (RAM disk).

On a 128k unit, 64k will be allocated as a program area and 64k as a data area. Within that data area, 1k will be reserved for directory, leaving 63k net for for actual data storage.

Similarily on a 384k unit, you find the same 64k area for program execution (including Memodos), 1k for directory and 319k for data storage.

FILES ON THE MEMO UNIT

Files under Memodos can be up to the maximum size of the RAM disk. Each file is allocated space in increments of 1k (clusters) which do not need to be contiguous.

The way a language stores data on disk must be taken into consideration.

MBASIC, for instance, separates each field with commas and encloses each string field between quotation marks for sequential files, hence an overhead od 1 to 3 bytes per field. A formatted sequential file with the - using - statement or a random access file will create fixed lenght fields without delimiters. In both cases, however, numeric fields will first be converted to ASCII before output.

An interesting aspect of those files is that although the physical sector size is always 128 bytes on a CP/M machine, MBasic will block its records so as to occupy all of the available disk space. The same is not true for many other language implementations. Writing a 20-bytes record in Pascal MT+ might actually waste 108 bytes per output.

Other field size considerations must also be taken into account.

Pascal MT+ will reserve 10 bytes per numeric field if you use BCD arithmetic. A record containing many such fields would waste much space even if the data stored was never more than 9,99 $. In the real mode of arithmetic Pascal will reserve 4 bytes per field.

MBasic has no BCD arithmetics. It uses 4 bytes for single precision and 8 bytes for double precision real variables.

On the other hand, Cobol and Pl1 reserve only the space necessary to fit your type declaration.

One last consideration on space allocation for Memodos data files:

> Each file is allocated space in increments of 1k. This will be of no consequence in most cases except if you are considering units of minimal memory, say 96k. That would leave only 31k of RAM disk and a large number of files could waste badly wanted space. In such a situation one would consider grouping different data records in one file with 10 fields or just increment the total memory capacity of the units.

PROGRAM SIZE

The actual program execution area is always 64k no matter the total amount of memory installed in a given unit.

You have about 48k available for your application program which is quite sufficient in most cases.

Two techniques can be used for those applications where a larger program is needed.

One is program chaining which is a feature of most languages under CP/M. The other one is the overlay technique which can be done in Pascal, PL1 and Cobol among others.

6- THE CHOICE OF A PROGRAMMING LANGUAGE

TYPES OF LANGUAGES

The different languages available under Memodos come under 3 general categories:

A) THREADED CODES

Forth is a common example of a threaded code language. Though this type of language processor is very space efficient it yelds to a rather ackward and difficult to read program and finds little acceptance in industry.

B) INTERPRETERS AND PSEUDO-INTERPRETERS

Basic is by far the most commonly known interpreted language, specially in the fields of mini and micro computers. Microsoft Basic is available under Memodos in interpreted as well as compiled form. Moreover, the IBM/PC is upward compatible with the 8 bits version for Memodos.

Pseudo-interpreters are a variant in that the source code is converted in the form of token words, themselves interpreted by a run-time system. This approach is somewhat more compact and faster than a fully interpreted one but interactive execution is lost.

C) COMPILERS

These, of course, generate native code to the target CPU. Almost any language is available under Memodos in compiled form from Basic to Cobol thru Fortran, Pascal, ...

Here are some guidelines in choosing the language for your application:

A language interpreter or pseudo-interpreter such as Basic will occupy a fair amount of space for a small program but will have a slow and gradual growth as the program increases in complexity.

On the other hand, the same program can be compiled into a compact object code that will grow in direct proportion to increased complexity.

As a case in point, Texas Instruments offers both the peuso-code and the binary version of Pascal on their line of computers. The P-code version will generate a considerably smaller system for a large, complex program while the binary version is recommended for a small program or when execution is an important factor.

PL1/80 is known as being the fastest and most compact compiler for the Z80 while forth will generate even smaller code but at the expense of a very poor execution speed and readability.

In conclusion, compilers are generally recommended except in those rare cases where space is an extremely acute factor.

All those considerations of chapters 5 to 6 may seem overly complex for such a small unit. In fact, they are not, as you probably expected I would say at this point.

There is no more to consider about Memo in terms of programming language, program and data size... than there is about any other type of computer system on the market, large or small.

Except maybe for this: portable, battery operated memory is more expensive to the byte than it is on a regular disk or tape. If you plan on using a large number of units then you either want to save as much as possible on equipment or to predict what could amount to substantial hidden costs. If you pay proper attention to these factors and if you measure the different elements on a development system as per chapter 4 then it is quite possible to evaluate exactly what your actual needs will be.

7- FINAL RESULTS

Very well! Now we know all about which language we are going to use and how big this is all going to be.

But we must keep in mind that the very reason for such a planning and programming effort is to get the **correct data** as fast as possible and **process** it ont your central computer.

CONVERSION PROBLEMS

The best way to avoid conversion problems is to store data in the Memo unit as simple ASCII fields in a fixed format or seperated by delimiters a La Basic. This of course at the expense of increased storage space and communication time.

Here are some simple guidelinees however in case you have to perform data conversion: as a general rule, bit-string, boolean and numeric fields will need data conversion.

Bit-strings will be fairly easy to handle. Providing your host computer language has facilities for such manipulations.

Boolean values will of course be either zero or non-zero, which is which depends on the actual language implementation.

Language processors on Z-80-type machines store integers as two bytes fields with the least significant part first.
This must be verified in your language documentation though as some implementations extend this up to 3 or 4 bytes fields.

Non-integer numerics will have the most variations amongst different systems and languages. A comp-3 item in Cobol-80 will certainly have a different internal representation than the same in Vax Cobol. Similarily, a Fortran-80 real item will not have the same Mantissa an exponent representation on a prime computer system.

A carefull analysis of your application on the Memo and of the various data representations involved will allow a straight-forward development of your conversion program.

- NOTES ON COMPATIBILITY BETWEEN MEMO AND THE IBM PC

Almost every Z-80 language supplier has developed a similar system for the PC. These are upward source code compatible and use coherent internal data representation. This means that your data collected on the Memo unit can be processed directly on the PC or at least converted by the PC into the format required on your mainframe.